



축산물 이용 및 가공

Emergence and genomic characterization of carbapenem-resistant *Morganella morganii* carrying *bla_{NDM-1}* isolated from a Korean commercial livestock farm

Soojin Lim^{1,2}, Seojeong Choi², Tae Seon Cha², Ye Bin Kim², Ji Hyung Kim²

¹Laboratory of Aquatic Biomedicine, College of Veterinary Medicine and Research Institute for Veterinary Science, Seoul National University, Korea

²Department of Food Science and Biotechnology, College of BioNano Technology, Gachon University, Korea

Morganella morganii is a Gram-negative opportunistic pathogen widely distributed in humans, animals, and environmental sources. Its intrinsic multidrug resistance is particularly concerning, as the acquisition of carbapenemase genes may further limit therapeutic options and facilitate the dissemination of antimicrobial resistance genes (ARGs). Here, we report the first NDM-1-producing *M. morganii* isolate identified in the Korean livestock farm. The isolate GCUSY-1A was recovered from a farm-related environmental sample during routine surveillance at a local farm in 2024. Antimicrobial susceptibility testing confirmed a pan-drug-resistant (PDR) phenotype, with resistance to all tested agents, including carbapenems, aminoglycosides, and fluoroquinolones. Hybrid Illumina/PacBio sequencing revealed a 3,927,038-bp chromosome and a 265,008-bp plasmid. Comparative ARG profiling against 1,365 *M. morganii* genomes showed that GCUSY-1A harbored 32 ARGs, the highest number reported to date. Of these, 21 ARGs, including *bla_{OXA-1}* and *bla_{DHA-10}*, were chromosomal, whereas 11 ARGs, including *bla_{NDM-1}*, *bla_{OXA-10}*, and *cfrA*, were plasmid-borne. Replicon typing identified the plasmid as an *Inc_{pCHS4.1-3}* lineage, a replicon frequently related to the NDM dissemination in Morganellaceae. Core-genome SNP analysis further showed a close clustering between GCUSY-1A and clinical/environmental strains, suggesting ARG circulation across human, animal, and environmental sectors. These findings highlight the potential role of livestock-associated *M. morganii* as a reservoir of ARGs and underscore the need for systematic genomic surveillance within a One Health framework.

Key words : *Morganella morganii*, antibiotic resistance, swine farm, carbapenemase, *bla_{NDM-1}*

Isolation and characterization of a novel bacteriophage vB_SenP-GCUTh1 infecting *Salmonella enterica* serovar Thompson

Yejin Seo*, Tae Seon Cha, Ji Hyung Kim

Department of Food Science and Biotechnology, College of Bionano Technology, Gachon University, Korea

Salmonella enterica serovar Thompson (*S. Thompson*) is a major cause of foodborne gastroenteritis associated with contaminated poultry and dairy products. In this study, a novel lytic phage, vB_SenP-GCUTh1 (GCUTh1), was isolated and characterized. GCUTh1 was isolated from a wastewater treatment facility using *Salmonella* Thompson as the host. The phage showed strong lytic activity against *S. Thompson*, *S. Montevideo*, and *S. Infantis*, with moderate-to-high efficiency of plating (EOP) values, and interestingly, also efficiently infected carbapenem-resistant *S. Thompson*. The phage exhibited a short latent period, large burst size, and high stability across a wide range of pH and temperature conditions. Whole genome sequencing revealed that GCUTh1 possessed 39,528 bp dsDNA with 48.7% G+C content, and no virulence or antibiotic resistance genes were detected. A total of 45 ORFs were predicted, and no tRNA genes were identified, supporting its lytic lifestyle. Phylogenetic analysis classified the phage within the genus *Berlinvirus*, and comparative genome analysis indicated the uniqueness of the phage. Moreover, the phage showed efficient inhibitory ability against *S. Thompson* in the food matrix, thus highlighting its potential in food safety. These findings suggest that the newly isolated phage will have strong potential as an alternative biocontrol agent against *S. Thompson* in the livestock industry.

Key words : *Salmonella* Thompson, bacteriophage, lytic phage, food safety, egg liquid

Effects of fattening starting age and slaughter age on carcass traits and meat quality of Hanwoo steers

Oni Faith Oluwaseyi^{1*}, Shine Htet Aung², Phyto Htet Htet Kyaw¹,
Madiththe Gedara Asela Sandaruwan Abeyrathna¹, Byeolee Kang¹, DongGyu Lee¹, Ki-Chang Nam¹

¹Department of Animal Science & Technology, Sunchon National University, Suncheon 57922, Korea

²Department of Zoology, Kyaukse University, Kyaukse 05151, Myanmar

Determining the optimal slaughter age in Hanwoo beef production requires balancing market demand, carcass quality, production efficiency, feed utilization, and greenhouse gas emissions associated with prolonged fattening. This study examined the effects of fattening starting age (10, 13 months) and slaughter age (26, 28, 30 months) on carcass traits and meat quality using a 2×3 factorial design with 48 Hanwoo steers under standardized conditions. Live weight, carcass weight, dressing percentage, and meat yield showed no significant differences ($p > 0.05$), though performance increased numerically with slaughter age. Significant effects ($p < 0.05$) occurred in inedible portion and loin weights, peaking at 28 months. Meat quality improved significantly with age: water-holding capacity increased, and cooking loss decreased ($p < 0.05$), indicating better moisture retention. Muscle pH, lightness, ash content, and oxidative stability remained unaffected ($p > 0.05$). Slaughter age exerted a stronger influence than fattening starting age on both carcass characteristics and meat quality. The intermediate slaughter age optimized valuable cut development, processing yield, and premium-quality grade achievement while avoiding the diminishing returns observed at 30 months. Under this study, these findings suggest slaughtering Hanwoo steers at approximately 28 months may provide an optimal balance between carcass performance, meat quality, and production efficiency.

Key words : Hanwoo steers, fattening starting age, slaughter age, optimal slaughter, carcass characteristics, meat quality, production efficiency

Quality and volatile changes of Korean native black goat meat by refrigerated storage and cooking

Jeong Beom Ju*, Dongheon Lee, Seokjun Lee, Jinyi Che, Cheorun Jo

Department of Agricultural Biotechnology, Seoul National University, Seoul, Korea

Korean native black goat meat is recognized as a high-quality protein source with nutritional advantages, and its popularity has been expanding in Korea. However, the unique odor and toughness of black goat meat are the main hurdles for getting consumer's choice. Nonetheless, studies on quality and volatile changes during storage and cooking remain limited. Therefore, this study evaluated the changes in the quality characteristics of vacuum-packaged black goat longissimus muscle, including pH, color, shear force, texture, on days 0 and 4 of refrigerated storage. Additionally, volatile organic compounds (VOCs) of raw and cooked meat were compared. The results showed that pH significantly increased under vacuum packaging during storage ($p < 0.001$), while no significant changes were observed in color, shear force, or texture. A total of 22 VOCs were identified and quantified, 18 of which significantly increased in the raw meat after storage. However, after cooking, eight VOCs were significantly lower in meat on day 4 than that on day 0. Especially, four aldehydes, heptanal, hexanal, nonanal, and pentanal, significantly decreased when the meat was vacuum-packaged for 4 days, followed by cooking. These findings suggest that short-term storage and cooking could significantly change the pH and VOCs of black goat meat, which may be important in determining overall meat quality.

Key words : Korean native black goat meat, refrigerated storage, cooking, quality characteristics, volatile organic compounds

Development and validation of a refined automated muscle fiber analysis algorithm for immunohistochemistry images

Jaehoon Baek^{1,*}, Junyoung Park¹, Sumin Song¹, Huilin Cheng¹, Hyun-Jun Kim², Gap-Don Kim^{1,2}

¹Graduate School of International Agricultural Technology, Seoul National University, Korea

²Institutes of Green Bio Science and Technology, Seoul National University, Korea

Muscle fiber characteristics (MFC) reflect skeletal muscle properties and are closely associated with meat quality. However, immunohistochemistry (IHC) image analysis is time-consuming and prone to inter-analyst variability. Although a few automated MFC analysis algorithms have been reported, IHC images remain affected by color crosstalk and segmentation noise, causing misclassification and false detection. In this study, we refined a prototype-based automated analysis algorithm (PA) to improve noise reduction and classification stability. Moreover, we validated the refined algorithm (RA) against manual analysis as the reference standard using identical IHC images. Relative fiber number (RFN), mean cross-sectional area (CSA), composition error, and agreement metrics (MAE, bias, RMSE, concordance correlation coefficient [CCC], and intraclass correlation coefficient [ICC]) were evaluated. Error reduction was assessed using the Wilcoxon signed-rank test. The RA demonstrated improved agreement with manual analysis compared to the PA, particularly for Type I (CCC: 0.956 to 0.985; MAE: 2.36 to 1.52) and Type IIX fibers (CCC: 0.908 to 0.950; MAE: 3.21 to 2.42). Composition error was significantly reduced (4.02 to 3.07), while total fiber count, mean CSA, and CSA distribution were not significantly affected. These results indicate that targeted PA refinement enhances classification accuracy and robustness to noise without distorting the fiber size distribution, supporting its applicability in fluorescence image-based MFC analysis.

Key words : muscle fiber characteristics, muscle fiber analysis, immunohistochemistry, automated image analysis

The effect of intramuscular fat content in beef on the bioaccessibility of protein and lipids

Minkyung Woo¹, Seul-Ki-Chan Jeong¹, Hayeon Jeon¹, Soeun Kim¹, Seokhee Han¹, Seonmin Lee², Samooel Jung¹

¹Department of Animal Biosystems Science, Chungnam National University, Daejeon 34134, Korea

²Research Group of Food Processing, Korea Food Research Institute, Wanju 55365, Korea

This study analyzed the protein and lipid digestion behaviors of beef loin muscle with different intramuscular fat levels through *in vitro* digestion. Six loin muscle samples were acquired from Hanwoo steers 72 h after slaughter. Based on the results of the general composition analysis, the treatment classified the group with a crude fat content of 25% or more as the high fat (HF) group and the group with 18% or less as the low fat (LF) group. HF group showed significantly lower hardness and cohesiveness compared to the LF group ($p < 0.05$). After *in vitro* digestion, the content of α -amino groups in the beef was significantly higher in the HF group than in the LF group in both gastric and intestinal digesta ($p < 0.05$). The content of the low molecular weight proteins (< 3 kDa) in the *in vitro* digesta was significantly higher in the HF group than in the LF group ($p < 0.05$). In contrast, during *in vitro* intestinal digestion, free fatty acid release occurred more rapidly and to a greater extent in the LF group than in the HF group. Accordingly, the intestinal digesta of the LF group contained significantly higher levels of free fatty acids than that of the HF group ($p < 0.05$). Therefore, these results suggest that the intramuscular fat content of beef may influence the digestibility of proteins and lipids *in vitro*.

Key words : beef, bioaccessibility, protein digestibility, lipid digestibility, *in vitro* digestion

Identification of proteins associated with quality changes in beef during aging

Junyoung Park¹, Sumin Song¹, Huilin Cheng¹, Jaehoon Baek¹, Hyun-Jun Kim², Gap-Don Kim^{1,2}

¹Graduate School of International Agricultural Technology, Seoul National University, Korea

²Institutes of Green Bio Science and Technology, Seoul National University, Korea

Increasing consumer demand for premium meat has led to increased production of aged beef to enhance flavor and tenderness. Aging improves tenderness through the proteolytic degradation of muscle proteins and enhances flavor via the release of free amino acids. However, the specific proteins that are degraded and the underlying mechanisms remain unclear. Therefore, in this study, we evaluated proteolysis during beef aging using a peptidomics-based approach. Strip loin and tenderloin samples acquired from 10 Hanwoo steers (30.5 months, 438 ± 0.34 kg carcass weight) were aged as 3-cm-thick steaks for 1, 2, and 3 weeks. Meat quality traits (color, pH, purge loss, drip loss, cooking loss, and Warner–Bratzler shear force) and peptides were analyzed. We used one-way ANOVA to analyze meat quality data, and protein alterations were assessed based on significantly different unique peptides ($p < 0.05$). pH, purge loss, or cooking loss did not significantly differ ($p > 0.05$), whereas shear force and lightness decreased and redness and yellowness increased ($p < 0.05$). Seventeen proteins exhibited significant changes during aging, with 12 proteins exhibiting consistent increasing or decreasing trends. Among these, four core proteins were associated with carbohydrate catabolic and methylglyoxal metabolic processes, and 11 proteins were distributed in the cytoplasm. These results suggest that protein degradation patterns contribute to variations in aged meat quality, and highlight their potential as predictive markers for meat quality.

Key words : beef, aging, meat quality, protein, peptidomics

Comparison of peptide profile similarity between fresh and spoiled pork cuts

Sumin Song^{1,*}, Junyoung Park¹, Huilin Cheng¹, Jaehoon Baek¹, Hyun-Jun Kim², Gap-Don Kim^{1,2}

¹Graduate School of International Agricultural Technology, Seoul National University, Korea

²Institutes of Green Bio Science and Technology, Seoul National University, Korea

Muscle constitutes a major part of meat. During storage and spoilage, muscle proteins are degraded into peptides and amino acids. Meat peptide profiles differ depending on factors such as animal species, breed, cuts, and storage conditions. In the present study, we compared the similarity of peptide profiles among pork cuts in fresh and spoiled meat and evaluated whether cuts with similar peptide profiles in the fresh state have similar patterns of peptide changes during spoilages. Pork cuts (n = 3, each) of loin (L), skirt (S), belly (B), and jowl (J) were used. Samples were classified as fresh meat (FR; $\leq 2 \log \text{CFU/g}$, 1 day) or spoiled meat (SP; $> 7 \log \text{CFU/g}$, 14 days, aerobic packing). In FR, B and J showed the highest peptide profile similarity (0.43), whereas S showed a relatively low similarity to the other cuts. In SP, B and L showed the highest similarity (0.66), whereas L and J showed the lowest similarity (0.40). In addition, paired delta analysis of peptide changes between FR and SP showed B and L to have the most similar change patterns (0.68), whereas L and J had the lowest similarity (0.53). When only the newly identified peptides in SP were compared, B and J showed the highest similarity. Principal coordinate analysis (PCoA) and PERMANOVA results showed that peptide profiles differed significantly between FR and SP, regardless of pork cut, whereas no significant difference was observed among cuts. The similarity in peptide profiles among pork cuts differed between FR and SP, indicating that cuts with similar peptide profiles in the fresh state did not exhibit similar peptide change patterns during spoilage. Thus, peptide degradation and changes differed among pork cuts during spoilage, suggesting that the intrinsic characteristics of each muscle cut may influence changes in the peptide profile.

Key words : muscle cut, spoilage, peptide profile

From pig feces to functional feed additives: Development of multi-strain probiotics for gut health in pigs

Saeyoun Shin¹, Sua Jin¹, Subin Kim¹, Ayeong Jo¹, Kiyeop Kim¹, Suhong Jeon¹, Sejong Oh^{1,*}

¹Animal Science, Chonnam National University, Gwangju, Korea

This study was conducted to develop a solid-state fermented probiotic feed additive for improving intestinal robustness in growing and finishing pigs. Probiotic candidate strains were isolated from healthy sow and piglet feces, kimchi, and other biological samples. Based on acid tolerance, bile tolerance, and intestinal adhesion ability, four strains with high overall scores were selected: *Limosilactobacillus fermentum*, *Lactiplantibacillus plantarum*, *Lactilactobacillus sakei*, and *Enterococcus faecium*. The selected strains passed safety evaluations including hemolysis, antibiotic resistance, biogenic amine production, and bile salt hydrolase activity. In addition, the strains showed anti-inflammatory and antioxidant activities under LPS-induced inflammatory conditions, suggesting their potential to improve intestinal health. Based on these strains, a solid-state fermented probiotic product was developed using wheat bran, soybean meal, corn, and molasses. Fermentation conditions including substrate composition, moisture content, and fermentation time were optimized by comparing viable cell counts. The optimized fermented product showed high viable cell counts and increased beneficial metabolites such as organic acids. These results suggest that the developed multi-strain solid-state fermented probiotic product could be used as a functional feed additive for improving gut health in growing and finishing pigs.

Key words : pig, multi-strain probiotics, feed additive, gut health

Association of postmortem metabolic characteristics and ultimate pH in *longissimus dorsi* of Korean native black goat

Kang-Jin Jeong¹, Jeong-Uk Eom², Jin-Kyu Seo², Han-Sul Yang^{1,2}

¹Division of Applied Life Science (BK21 Four), Gyeongsang National University, Jinju 52828, Korea

²Institute of Agriculture and Life Science, Gyeongsang National University, Jinju 52828, Korea

Despite the association between post-mortem metabolites and the ultimate pH of meat, relevant studies on the Korean native black goat (KNBG) are limited. Hence, this study was conducted to investigate the nucleotides during post-mortem time on KNBG *Longissimus dorsi*. KNBG ($n = 30$, BW = 46.60 ± 4.93 kg, $\geq 35\%$ genetic composition as KNBG) were slaughtered, and chilled at $5^{\circ}\text{C}/\text{h}$. The data were collected for pH, adenosine triphosphate (ATP), adenosine diphosphate (ADP), adenosine monophosphate (AMP), and inosine monophosphate (IMP) contents, which were measured (1–48 h). Data were analyzed using SAS 9.4 PROC GLIMMIX (Tukey-Kramer, $p < 0.05$) and PROC REG to evaluate relationships between metabolites and pH. As a result, the ultimate pH was 5.81. ATP and ADP contents significantly declined within the 1–2 h post-mortem, while AMP and IMP contents increased from 4h onwards ($< .0001$). Regression analysis showed that pH was positively correlated with ATP ($\beta = 0.42$, $R^2 = 0.21$) and ADP ($\beta = 0.42$, $R^2 = 0.24$), but negatively correlated with IMP ($\beta = -0.03$, $R^2 = 0.29$). Rapid initial ATP and ADP degradation (1–2 h) and conversion to IMP induce (after 4 h) a high ultimate pH by terminating the ATP resynthesis process. The results indicate that the initial 2 h nucleotide turnover is closely linked to the ultimate pH of KNBG, suggesting that managing early post-mortem metabolism could be enhance meat quality.

Key words : Korean native black goat, postmortem, meat quality

Effects of initial chilling rate on the oxidative stability and volatile compound profiles of Korean native black goat loin under different storage conditions

Jun-Won Sung¹, Jeong-Uk Eom², Jin-Kyu Seo², Han-Sul Yang^{1,2}

¹Division of Applied Life Science (BK21 Four), Gyeongsang National University, Jinju 52828, Korea

²Institute of Agriculture and Life Science, Gyeongsang National University, Jinju 52828, Korea

Korean native black goats are highly sensitive to temperature changes due to their relatively small carcass size and thin subcutaneous fat layer, making the initial chilling rate critical for meat quality. This study investigated the effects of delayed (10°C) versus rapid (0°C) initial chilling on black goat loins during refrigerated (4°C for 10 days) and frozen (60 days) storage. Carcasses were exposed to treatment temperatures for 6 hours, then chilled at 4°C until 48 hours post-slaughter; frozen samples were thawed after 60 days and analyzed following the same protocol as the refrigerated group. The samples were analyzed for pH, lipid oxidation (TBARS), protein oxidation (carbonyl content), and volatile organic compounds (VOCs). While pH values showed no significant difference ($p > 0.05$), lipid oxidation was significantly higher in the rapid chilling group for frozen storage ($p < 0.01$). Protein oxidation was also higher in the rapid chilling group for refrigerated meat ($p < 0.05$). Peak areas of aldehyde-based volatile compounds (nonanal and hexanal), which serve as oxidative indicators in meat, were significantly larger in the rapid chilling group for refrigerated meat ($p < 0.05$). In conclusion, delayed chilling is considered a more suitable initial chilling method for Korean native black goats, as it provides better oxidative stability compared to rapid chilling.

Key words : Korean native black goat, chilling rate, storage characteristic

Effect of initial carcass chilling conditions on oxidative stability of *Longissimus dorsi* in Korean native black goats

Jae-Hyeok OK¹, Jeong-Uk Eom², Jin-Kyu Seo², Han-Sul Yang^{1,2}

¹Division of Applied Life Science (BK21 Four), Gyeongsang National University, Jinju 52828, Korea

²Institute of Agriculture and Life Science, Gyeongsang National University, Jinju 52828, Korea

The carcass chilling rate determines meat quality and shelf-life through post-mortem muscle temperature changes. This is particularly critical in Korean native black goats (KNBG), whose smaller carcass size makes them more susceptible to chilling rates than larger livestock. This study evaluated the impact of different chilling rates on the oxidative stability and volatile compounds of KNBG loins during storage. Twenty 12-month-old KNBGs raised under identical conditions were randomly assigned to slow (3°C/h decrease) or fast (6°C/h decrease) chilling treatments. Once the carcass core temperature reached 10°C, carcasses were chilled at $5 \pm 1^\circ\text{C}$ for 48 h, then loins were separated and stored at 4°C for 1, 5, 10, or 15 days. The ultimate pH was significantly higher in the fast group than in the slow group ($p < 0.01$). TBARS and carbonyl contents, indicators of lipid and protein oxidation, increased significantly during storage and were higher in the fast treatment, with the most notable differences on days 10 and 15 ($p < 0.01$). Regarding volatile compounds, the fast group showed higher peak intensities of representative aldehydes, including hexanal, heptanal, octanal, and nonanal. In conclusion, the initial chilling rate could influence the oxidative stability of KNBG loins. Given the specific carcass characteristics of KNBGs, slow chilling may be considered more suitable than fast chilling for ensuring meat quality and safety.

Key words : black goat, chilling condition, shelf-life

Impact of dietary betaine supplementation on the quality characteristics of refrigerated and frozen-thawed pork loin

Nayeem Mia¹, Jeong-Uk Eom², Kang-Jin Jeong¹, Jin-Kyu Seo², Han-Sul Yang^{1,2}

¹Division of Applied Life Science (BK21 Four), Gyeongsang National University, Jinju 52828, Korea

²Institute of Agriculture and Life Science Gyeongsang National University, Jinju 52828, Korea

This study investigated the effects of dietary supplementation with 0.5% betaine on the quality characteristics and storage stability of pork loin under refrigerated and frozen–thawed conditions. Three-way crossbred pigs were used, and the treatment group was fed a betaine-supplemented diet for five months after weaning, whereas the control group received a normal commercial diet. Pork loin samples were analyzed for proximate composition, physicochemical properties, texture profile, lipid oxidation, volatile compounds, and sensory characteristics. The treatment group showed higher moisture and protein contents with relatively lower fat content compared with the control group. Dietary betaine supplementation significantly reduced cooking loss, shear force, hardness, and yellowness values of pork loin during refrigerated storage ($p < 0.05$). Lower aldehyde formation was observed in the treatment group at 14 d of storage, indicating improved oxidative stability and storage quality. Under frozen–thawed conditions, pork loin from the betaine-fed group showed lower thawing loss and higher sensory acceptability, suggesting that dietary betaine can effectively improve pork loin quality and stability during storage.

Key words : betaine, pork loin, oxidative stability, meat quality, water-holding capacity

Detection of foreign materials in chicken meat using SWIR hyperspectral imaging

Juntae Kim¹, Lorna Bridget Alal², Yun-Kil Kwon³, Sun-Moon Kang⁴, Byoung-Kwan Cho^{1,2}

¹Department of Smart Agriculture Systems Machinery Engineering, Chungnam National University, Daejeon, Korea

²Department of Smart Agricultural Systems, Chungnam National University, Daejeon 34134, Korea

³XCore System Co., Ltd., Sejong 30141, Korea

⁴Animal Products Research and Development Division, National Institute of Animal Science, Wanju 55365, Korea

Chicken meat is one of the most widely consumed animal protein sources worldwide, and its demand continues to increase according to FAO and OECD reports. However, foreign material contamination remains a critical food safety concern in poultry processing, where contaminants from gloves, masks, machine parts, plastics, wood, glass, and metals may be introduced. This study investigated the feasibility of hyperspectral imaging in the 1,000–2,200 nm range for detecting foreign materials (FMs) on chicken meat surfaces using a binary partial least squares discriminant analysis (PLS-DA) model. Fifty fresh broiler samples, including 19 breasts and 31 drumsticks, were purchased and used without freezing. Thirty types of FMs, including plastics, rubber, wood, metal, glass, textiles, and grease, were cut to approximately $5 \times 5 \text{ mm}^2$ based on FDA and USDA criteria for hard and sharp contaminants. Chicken samples were first scanned without FMs to obtain reference spectra and then scanned with FMs on the surface. A total of 32 hyperspectral images were acquired and processed to extract chicken and FM spectra. Various preprocessing methods were evaluated, and the binary PLS-DA model achieved a validation accuracy of approximately 98.9%–99.0%. These results indicate that hyperspectral imaging combined with PLS-DA can effectively distinguish FMs from chicken meat. Future work will expand this binary model into hierarchical detection logic for segmenting FM pixels, grouping object-level regions, and classifying specific material categories.

Key words : hyperspectral imaging, chicken meat, foreign material detection, binary classification, PLS-DA

Handheld NIR spectrometer for beef carcass composition and oleic acid prediction

Juntae Kim¹, Woo-Sung Chu², Hae-Seong Jeong³, Byoung-Kwan Cho^{1,4}

¹Department of Smart Agriculture Systems Machinery Engineering, Chungnam National University,
Daejeon 34134, Korea

²Solution Factory Co., Ltd., Daejeon 34025, Korea

³Korea Institute for Animal Products Quality Evaluation, Sejong 30100, Korea

⁴Department of Smart Agricultural Systems, Chungnam National University, Daejeon 34134, Korea

This study developed a reflection-mode handheld near-infrared (NIR) spectrometer for real-time prediction of proximate composition and oleic acid content in Hanwoo beef carcasses. The system covered the 1,000–1,700 nm range and used a 40 mm illumination window to improve measurement reliability on heterogeneous carcass surfaces. Reflectance spectra were collected from 243 chilled carcasses with beef marbling scores from 1 to 9, and reference values for moisture, crude protein, crude fat, and oleic acid were obtained using standard laboratory analyses. Partial least squares regression and Random Forest models were developed using preprocessed spectra. As marbling score increased, moisture and crude protein decreased, while crude fat and oleic acid increased. Random Forest outperformed PLSR, achieving prediction R^2 values of 0.89, 0.90, 0.91, and 0.86 for moisture, crude protein, crude fat, and oleic acid, respectively. These results indicate that the developed handheld NIR system can rapidly and non-destructively assess key nutritional and quality traits of beef carcasses under slaughterhouse conditions.

Key words : handheld NIR spectrometer, beef carcass, proximate composition, oleic acid, random forest

Anaerobic isolation and identification of *Propionibacterium freudenreichii* and lactic acid bacteria from commercial emmental cheese and their potential cross-feeding interactions

Yuri Kim¹, Joon Pyo Oh^{1,2}, Seungha Kang^{1,2}

¹Graduate School of International Agricultural Technology, Seoul National University,
Pyeongchang 25354, Korea

²Institutes of Green Bio Science and Technology, Seoul National University, Pyeongchang 25354, Korea

The development of next-generation probiotics increasingly demands a shift from single-strain selection toward the design of functionally complementary multi-strain consortia capable of cross-feeding interactions. In this study, two commercial Emmental cheese products, EntreMont (EM) and Paysan Breton (PB), were used as isolation sources for anaerobic candidate probiotic bacteria. Inner portions of each cheese sample, minimally exposed to oxygen, were inoculated into yeast extract medium using Hungate tubes and incubated anaerobically at 30°C for up to 48 h. Following sequential subculturing, anaerobic plating, and colony isolation, eight representative isolates were selected based on colony morphology and growth characteristics. Bacterial identification was performed via DNA extraction, PCR amplification of the 16S rRNA gene using universal primers 27F and 1492R, supplementary internal sequencing for near full-length 16S rRNA gene coverage, and NCBI BLAST analysis. Species-specific PCR targeting *P. freudenreichii* was additionally conducted for confirmation. Sequencing results identified EM1 and PB5 as *Lactiplantibacillus plantarum* (99.93% and 99.72% sequence similarity, respectively), EM12 as *Levilactobacillus brevis* (99.93%), and PB13 as *Pediococcus pentosaceus* (98.13%). Four isolates — EM5, EM6, PB11, and PB16 — were identified as *Propionibacterium freudenreichii* subsp. *shermanii*, with sequence similarities ranging from 98.37% to 99.91%. Under the tested culture conditions, *P. freudenreichii* isolates exhibited comparatively faster growth than the isolated lactic acid bacteria. Collectively, these findings indicate that commercial Emmental cheese represents a valuable reservoir for propionate-producing and lactic acid-producing candidate strains suited for cross-feeding-based multi-strain probiotic development. Further investigation into metabolic compatibility, cross-feeding potential, and functional stability among the isolated strains is warranted to advance their application in next-generation probiotic formulations.

Key words : probiotics, cross-feeding, emmental cheese, propionate, lactic acid bacteria, 16S rRNA gene

Microbial succession and proteolytic activity during high-temperature fermentation of traditional wheat-based nuruk

Gyeong-seok Kang¹, Jeong Woong Park², Seungwoo Son³, Jaeyoung Heo^{2,3}, Donghyun Shin^{1,4}

¹Department of Agricultural Convergence Technology, Jeonbuk National University, Jeonju 54896, Korea

²Department of Animal Biotechnology, Jeonbuk National University, Jeonju 54896, Korea

³Melliens Inc., Jeonju, Korea

⁴The Korean Society of Animal Big Data Research, Korean Society of Animal Science and Technology, Seoul 06367, Korea

Efficient protein bioconversion and amino acid metabolism are critical determinants of productivity in livestock-related fermentation systems, including feed fermentation and silage processing. Traditional nuruk is a solid-state fermentation system operating under high-temperature and low-moisture conditions that selectively enriches stress-tolerant microorganisms with strong proteolytic potential, making it a compelling model for identifying functionally relevant microbial resources in livestock applications. In this study, metagenomic analysis and amino acid profiling were conducted to investigate microbial succession and protease-associated metabolic changes during the traditional manufacturing process of wheat-based nuruk. Fermentation at 45°C substantially reshaped both bacterial and fungal communities, driving the dominance of thermotolerant fungi, particularly *Saccharomycopsis* and *Lichtheimia*. Concurrently, protease activity increased sharply, accompanied by marked accumulation of total free amino acids and proline. Correlation analysis revealed strong positive associations between dominant microbial taxa and protease-related biochemical parameters, indicating active proteolytic metabolism under thermal stress. Progressive decline in fungal diversity further reflected the selective enrichment of functionally adapted microbiomes. These findings suggest that traditional nuruk serves as a valuable reservoir of stress-tolerant, protease-producing microbiomes. The thermotolerant taxa identified here may offer practical utility as microbial resources for improving protein degradation efficiency and amino acid availability in livestock feed fermentation systems.

Key words : wheat-based nuruk, solid-state fermentation, thermotolerant microbiome, protease activity, amino acid metabolism, livestock feed fermentation

Impact of different black soldier fly powder supplementation levels on broiler chicken breast meat quality

Hyeon-Yeop Kim¹, Dong-Ju Moon¹, Kang-Jin Jeong², Jin-Kyu Seo^{1,3}, Han-Sul Yang^{1,2}

¹Division of Animal Science, Gyeongsang National University, Jinju, Korea

²Division of Applied Life Science (BK21 Four), Gyeongsang National University, Jinju, Korea

³Institute of Agriculture and Life Science, Gyeongsang National University, Jinju, Korea

This study was conducted to evaluate the feed value by analyzing the effects of black soldier fly powder (BSFP) feeding levels on the physicochemical properties and storage stability of broiler breast meat. Chicken breast meat treated with BSFP at different feeding levels (a basal diet supplemented with 0 [control], 0.1 [T1], 0.5 [T2], or 1.0% BSFP [T3]) was used as the test material, and meat color, pH, shear force, cooking loss, lipid oxidation, and DPPH radical scavenging activity were measured before and after storage. Proximate composition showed no significant differences in moisture, protein, fat, and ash content following the feeding of BSFP ($p > 0.05$). Lightness (CIE L^*) was significantly higher in all treatment groups compared to the control group ($p < 0.05$). There was no significant difference in cooking loss due to BSFP treatment ($p > 0.05$). The shear force of T3 was the highest than other treatments ($p < 0.05$). After 7 days of storage, lipid oxidation in T2 and T3 was significantly lower than in the control ($p < 0.05$). It is determined that the feeding of BSFP does not have a negative effect on meat color and water-holding capacity in broiler chicken breast. In particular, it is expected to improve storage stability by effectively inhibiting lipid oxidation during storage. Therefore, BSFP is considered to have high potential as a feed resource for improving meat quality and ensuring shelf-life.

Key words : black soldier fly powder, broiler chicken breast, meat quality, shelf-life

Effect of packaging method on physicochemical quality traits in goat meat during storage

Keonhui Kim, Inchan Back, Seohyeon Kong, Seokchan Lee, Junseong Hwang, Donggyun Yim*

Department of Animal Science and Biotechnology, Kyungpook National University, Sangju 37224, Korea

This study examined the influence of packaging methods on the physicochemical quality of goat meat during refrigerated storage ($1 \pm 0.5^{\circ}\text{C}$). Samples were stored under aerobic (AP) or vacuum packaging (VP) for 0, 3, and 7 days. Quality traits including pH, TBARS, drip loss, moisture, water activity, and color were analyzed. The pH decreased initially and increased later, with the lowest value observed in AP on day 3 ($p < 0.001$). TBARS values rose over time but were lower in VP on day 7 ($p < 0.001$). Drip loss increased progressively, while a^* and chroma values declined, indicating color deterioration. VP samples maintained lower lipid oxidation and better moisture retention than AP. Overall, VP effectively preserved goat meat quality during storage, suggesting a shelf life of up to 7 days under refrigeration.

Key words : goat meat, vacuum packaging, aerobic packaging, storage period, physicochemical properties