축산물 이용 및 가공

OE26001

Effects of slaughter age on enteric methane emissions and production efficiency in Hanwoo steers

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Beef cattle production is a major source of methane (CH_4) emissions due to enteric fermentation, contributing substantially to greenhouse gas outputs and reducing production efficiency. This study evaluated the effects of slaughter age on enteric methane emissions, production efficiency, and carcass characteristics in Hanwoo steers. Animals were slaughtered at 26, 28, and 30 months, and growth performance, feed intake, methane emissions, and emission intensity were compared. Slaughter age did not significantly affect final body weight, carcass weight, or dry matter intake; however, meat yield and lower loin weight were higher at 28 and 30 months. Average daily methane emissions were similar across treatments, indicating no effect of age on daily emission rates. However, total methane emissions and emission intensity per live weight, carcass weight, and meat yield increased significantly with slaughter age. These results indicate that extended feeding periods increase cumulative emissions without proportional efficiency gains. Although meat yield improved at 28 months, extending to 30 months provided limited additional benefits while increasing environmental impact. Therefore, slaughtering at 28 months appears to balance productivity and environmental efficiency under this study. Overall, optimizing slaughter age is an effective strategy to improve sustainability in Hanwoo beef production systems.

Key words : Hanwoo, methane emissions, slaughter age, efficiency, sustainability

OE26002

Predicting eating quality of pork shoulder butt using Vis/NIR hyperspectral imaging and machine learning models

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Predicting eating quality of pork is challenging due to its complex characteristics. Therefore, this study aimed to developed a framework for predicting pork eating quality clusters (EQC) by integrating sensory evaluation and electronic tongue data with visible/near-infrared hyperspectral imaging (Vis/NIR HSI). Pork shoulder butt samples (n = 189) were collected from four pig farms, and pork EQC were defined using k-means clustering (k = 2 and 3) based on saltiness and umami taste intensities obtained from both sensory and electronic tongue analyses. HSI data from muscle, fat, and entire meat were acquired using a two-stage partial least squares-discriminant analysis approach. Among these regions, MUSCLE spectra showed the highest classification performance. Feature selection and data augmentation were systematically evaluated using support vector machine (SVM), logistic regression (LR), and light gradient boosting machine models. In the binary classification, the combination of uninformative variable elimination and combined transformation yielded the best performance, with LR achieving a test F1-score of 0.806. In the three-class classification, SVM showed superior and more stable performance, achieving a test F1-score of 0.696. These results demonstrate that Vis/NIR HSI-based framework provides a non-destructive and practical approach for predicting and classifying pork eating quality in the meat industry.

Key words : pork shoulder butt, eating quality, hyperspectral imaging, machine learning

OE26003

Development of a non-destructive prediction model for crude fat and protein content in beef loin using hyperspectral imaging

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This study was conducted to non-destructively predict the crude fat and crude protein content (%) of beef loin using hyperspectral imaging (HSI) in the spectral range of 350–1,002 nm. A total of 120 beef loin samples were utilized for the analysis, which were partitioned into a calibration set and a prediction set at a ratio of 7:3 (n = 84 and 36, respectively). To improve prediction performance, various preprocessing methods, including standard normal variate (SNV), multiplicative scatter correction (MSC), and the first derivative, were compared. Furthermore, three variable selection methods, including Variable Importance in Projection (VIP), Random Frog, and Competitive Adaptive Reweighted Sampling (CARS), were applied to enhance model efficiency. The results demonstrated that the models using 21 and 25 optimal wavelengths selected by CARS for crude fat and crude protein, respectively, achieved the best performance. For crude fat, the prediction performance was R^2_P = 0.72, RMSEP = 3.172, and RPD = 1.90. For crude protein, the model achieved an R^2_P of 0.71, an RMSEP of 0.785, and an RPD of 1.86. Also, chemical distribution maps of these chemical components were visualized using the partial least squares regression (PLSR) models using optimal wavelengths. These findings indicate that HSI technology is a promising tool for the rapid and real-time monitoring of crude fat and protein in the meat industry

Key words: hyperspectral imaging, beef loin, crude fat, crude protein, PLSR

OE26004

Development of an oxygen-gradient-based 3D intestinal model platform for the discovery of next-generation livestock probiotics: validation of the intestinal barrier-enhancing effects of *Bifidobacterium adolescentis* OP820

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Early weaning in piglets induces intestinal barrier disruption and gut microbial imbalance, which are closely associated with diarrhea and reduced productivity. This study established an oxygen-gradient-based 3D villi co-culture system mimicking the intestinal microenvironment and evaluated the epithelial adhesion and barrier-enhancing effects of *Bifidobacterium adolescentis* OP820 selected from diverse environmental samples. The established system was designed to simultaneously reproduce hypoxic luminal conditions and oxygenated basal conditions. OP820 exhibited stable viability and strong adhesion ability within the system, particularly showing selective localization in the mucin-rich glycocalyx region. In addition, reduced adhesion under MUC13 and MUC17 knockdown conditions suggested that epithelial adhesion of OP820 was regulated in a transmembrane mucin-dependent manner. Furthermore, OP820 treatment restored the expression of TJP1, OCLN, and CLDN1 reduced under inflammatory conditions, thereby alleviating intestinal barrier dysfunction. These findings suggest that OP820 is a promising probiotic candidate adaptable to the intestinal mucosal environment and that the oxygen-gradient-based 3D co-culture system may serve as a useful platform for evaluating livestock probiotics.

Key words : livestock probiotics, gut commensal bacteria, *Bifidobacterium adolescentis* OP820, 3D villi co-culture system

OE26005

Protective effects of probiotic strains against gastric and intestinal inflammation and modeling of freeze-drying

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Lactobacillus johnsonii JNU3402 has attracted increasing attention as a functional probiotic strain due to its beneficial effects on gut health and anti-inflammatory activity. However, industrial applications of probiotics require improved stability during freeze-drying processes and scientific validation of their protective effects against gastrointestinal inflammation. Therefore, this study evaluated the freeze-drying characteristics of JNU3402 and its protective effects against gastritis and intestinal inflammation. Various cryoprotectant formulations based on trehalose, whey powder, and monosodium glutamate (MSG) were optimized using a modified simplex lattice model to improve the viability of JNU3402 during freeze-drying. The protective effects of JNU3402 were evaluated in inflammation-induced cell and animal models through histological and inflammatory analyses. Whole-genome analysis confirmed the presence of thioredoxin-related genes in JNU3402. Furthermore, probiotic treatment reduced reactive oxygen species (ROS) production and suppressed inflammatory cytokine expression, including TNF-α and IL-6, suggesting that the anti-inflammatory effects of JNU3402 may be associated with thioredoxin-related antioxidative mechanisms. Overall, this study provides fundamental insights into the industrial applicability and gastrointestinal protective potential of JNU3402 as a functional probiotic material.

Key words : *Lactobacillus johnsonii* JNU3402, freeze-drying, gastritis, intestinal inflammation

OE26006

Impacts of whey protein isolate edible coating on digestibility and bioactivity of cheeses during *in vitro* digestion

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This study investigated the effect of whey protein isolate (WPI) edible coating on the *in vitro* digestibility, bioactive properties, and metabolomic profiles of soft, semi-soft, and hard cheeses during simulated salivary, gastric, and intestinal digestion. WPI-coated cheeses exhibited significantly ($p < 0.05$) higher digestibility during selected digestion stages, particularly during intestinal digestion, compared with uncoated cheeses. Angiotensin-converting enzyme (ACE) inhibitory activity and antioxidant capacities, assessed by 2,2-diphenyl-1-picrythydrazyl (DPPH) and 2,2`-azinobis-(-3ethylbenzothiazoline-6-sulfonic acid) ($ABTS^{+}$) radical scavenging, were also significantly ($p < 0.05$) enhanced in coated samples depending on cheese type and digestion phase. The improved bioactivities were associated with increased release of bioactive peptides and amino acid metabolites during gastrointestinal digestion. NMR-based metabolomic analysis revealed distinct stage-specific metabolic patterns, with coated cheeses showing elevated levles of glutamine, glutamate, proline, carnosine, glycine, and arginine. Variable Importance in Projection analysis identified these metabolites as key contributors to digestion-stage discrimination and functional activities. Overall, WPI edible coatings significantly improved the nutritional functionality, antioxidant potential, and antihypertensive properties of cheeses, highlighting their potential application in the development of functional dairy products.

Key words : whey protein isolate (WPI), edible coating, cheese, *in vitro* digestion, digestibility, antioxidant activity