



번식 및 생리

Multigenerational effects of gestational BBP exposure on sperm function in mice

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Butyl benzyl phthalate (BBP), widely used in plastic manufacturing, is a potential endocrine disruptor and may pose a public health risk. However, its effects on male reproductive function across multiple generations (F2-F3) remain unclear. Therefore, this study investigated the multigenerational effects of gestational BBP exposure on sperm function, assessing generation-specific alterations. Pregnant female mice (F0) were orally administered BBP at doses of 0, 100, 250, and 500 mg/kg/day from gestation day (GD) 7 to 20 (until parturition). Male offspring from F1 to F3 generations were evaluated without additional exposure. The testis index of offspring mice was measured at postnatal day (PND) 78, along with sperm parameters, including sperm motility, capacitation status, and cell viability. The results showed that BBP exposure significantly decreased body weight in F1 and F2 offspring and reduced testis weight and anogenital distance (AGD) in all treated groups (F1-F3) compared with controls. In addition, sperm motility and motion parameters were significantly impaired in all treatment groups. Although no significant differences were observed in capacitation patterns and cell viability, BBP exposure induced abnormal alterations in the acrosome reaction. In conclusion, these findings suggest that gestational BBP exposure induces multigenerational effects on male reproductive function, potentially through heritable mechanisms, and highlight the long-term reproductive risks associated with BBP exposure.

Key words : butyl benzyl phthalate (BBP), multigenerational effects, gestational exposure, sperm function, male fertility

Seasonal effect on the morphological and viability parameters of Hanwoo spermatozoa

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Seasonal effects are closely associated with reproductive efficiency in Hanwoo cattle. In particular, seasonal effects may influence spermatogenesis and, in turn, affect sperm morphology and function. Therefore, this study aimed to investigate seasonal changes in sperm morphology and cell viability in Hanwoo cattle in different seasonal conditions. Semen was collected from 16 Hanwoo bulls via electroejaculation, with two consecutive ejaculates obtained per session from four bulls each week over a one month period. This collection was conducted over a period from October to March to observe the recovery from or transition between seasonal thermal conditions. In the present study, sperm morphology was examined via microscopic observation, while cell viability was evaluated using the hypo-osmotic swelling test (HOST). Morphological analysis showed that the normal sperm morphology rate significantly increased in February and March. Additionally, abnormalities in the midpiece and tail significantly decreased during the same period. Furthermore, HOST results showed that swelled spermatozoa significantly increased from January to March. Consequently, these results suggest that seasonal variation influences Hanwoospermatozoa morphology and viability, with significant differences observed among seasons.

Key words : Hanwoo, spermatozoa, seasonal effects, sperm morphology, hypo-osmotic swelling test

Male reproductive toxicity induced by metal components of PM2.5 from pig house exposure in mice

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This study aimed to investigate the effects of major metal components associated with particulate matter (PM2.5) on the male reproductive system, sperm function, and embryo development. PM2.5 samples were collected from a porcine farm and administered to male mice via intratracheal instillation. The mice were exposed to various concentrations of metal components, including calcium oxide (CaO), iron oxide (Fe₂O₃), aluminum oxide (Al₂O₃), zinc oxide (ZnO), lead oxide (PbO), and a combination of these metals. Fourteen days after exposure, testicular inflammation and abnormal sperm morphology were observed in the treated groups. Histopathological and biochemical analyses revealed elevated expression of inflammatory cytokines and oxidative stress-induced apoptosis in testicular tissue. Additionally, metal exposure adversely affected sperm morphology, capacitation status, serum testosterone levels, and testosterone biosynthesis. Notably, decreased sperm fertilizing capacity resulted in impaired embryo development. These findings demonstrate that PM2.5-associated metal components derived from pig farming environments exert detrimental effects on male reproductive health in mice and may pose reproductive risks in agricultural settings.

Key words : metal, particulate matter, reproductive system, sperm, testis

Effects of dimethyl sulfoxide on the pluripotency and differentiation ability of mouse embryonic stem cells

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The objective of this study was to investigate whether dimethyl sulfoxide (DMSO), a commonly used solvent in drug testing, influences the pluripotency and differentiation of mouse embryonic stem cells (mESCs) in the absence of leukemia inhibitory factor (LIF). In this study, 4-day-old mESC cultures were exposed to various concentrations of DMSO (0.1%, 0.5%, 1.0%, and 2.0%) to determine the safest and most effective dose for use as a solvent. mESCs maintained under standard pluripotency conditions without LIF were treated with DMSO. As a differentiation control, mESCs were also cultured in the absence of LIF alone. DMSO treatment increased the mRNA expression levels of pluripotency-associated markers. In contrast, DMSO significantly decreased the mRNA expression of the ectodermal marker β -tubulin3, the mesodermal marker Hand1, and the endodermal markers Foxa2 and Sox17 in mESCs. These findings suggest that DMSO enhances pluripotency while inhibiting the differentiation of mESCs. Furthermore, we demonstrate that members of the Tet oncogene family play an essential role in suppressing differentiation and DNA methylation in mESCs. Our results indicate that DMSO is suitable for maintaining mESC pluripotency in the absence of LIF and can preserve mESCs in an undifferentiated state. Therefore, DMSO may partially serve as a functional substitute for LIF.

Key words : mESCs, DMSO, LIF, pluripotency markers

Defatted *Tenebrio molitor* extract alleviated LPS-induced cytotoxicity and oxidative stress in porcine endometrium

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This study investigated the protective effects of defatted *Tenebrio molitor* (TM-DF), an extract obtained through optimized aqueous extraction and defatting processes, against lipopolysaccharide (LPS)-induced inflammation and oxidative stress in porcine luminal epithelial (pLE) cells. Based on cell viability analysis, the optimal concentrations for the further experiments were established at 5 µg/mL for TM-DF and 50 µg/mL for LPS. The results demonstrated that pre-treatment with TM-DF not only significantly mitigated the LPS-induced decrease in cell viability but also inhibited the generation of reactive oxygen species (ROS) and prevented the loss of mitochondrial membrane potential (MMP). Furthermore, TM-DF effectively suppressed the expression of heat shock proteins (HSPs) that were sharply increased by LPS treatment. Collectively, these findings suggest that TM-DF possesses potent bioactivity against oxidative damage in pLE cells, highlighting its potential for use as a functional feed additive or a therapeutic candidate.

Key words : *Tenebrio molitor*, LPS, porcine endometrium, ROS, heat shock proteins

Carbendazim induces G2/M phase arrest and mitochondrial dysfunction in bovine mammary epithelial cells

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Carbendazim, a benzimidazole-class fungicide, is widely used to control fungal infections in crops, fruits, and vegetables. Due to its broad agricultural application, both its residues and metabolites are commonly found in environmental compartments such as soil and water, raising concerns regarding its embryotoxic, reproductive, and potential carcinogenic effects. However, the impact of carbendazim on bovine mammary epithelial cells (MAC-T) remains unclear. In the present study, we demonstrated that carbendazim decreased MAC-T cell viability in a dose-dependent manner and significantly promoted early apoptotic cell death, and further induced G2/M phase arrest. Carbendazim also markedly increased cytosolic and mitochondrial calcium ion levels in MAC-T cells. In addition, carbendazim disrupted mitochondrial function and generated excessive oxidative stress, as evidenced by the loss of mitochondrial membrane potential. Collectively, these results indicate that carbendazim causes cytotoxic effects in bovine mammary epithelial cells through the disturbance of mitochondrial homeostasis and the modulation of cell cycle progression.

Key words : carbendazim, MAC-T cells, cytotoxicity, mitochondrial dysfunction, cell cycle arrest

Effects of Ashwagandha extract on testicular dysfunction caused by gut dysbiosis

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Ashwagandha is rich in bioactive withanolides, which provide potent antioxidant and anti-inflammatory effects. Given these benefits, the present study aimed to evaluate the potential of Ashwagandha extract (ASH) in reversing reproductive damage caused by antibiotic-induced dysbiosis in male mice. Nine-week-old male mice were randomly assigned to treatment groups: WT (control), WA (antibiotics), WA200 (antibiotics + 200 mg/kg ASH), WA300 (antibiotics + 300 mg/kg ASH), and ASH300 (ASH only). Antibiotics were administered for 4 weeks to induce dysbiosis, followed by oral ASH for 2 weeks. After sacrifice, serum and organ samples were collected to analyze hepatotoxicity markers, pro-inflammatory cytokines, spermatogenesis and reproductive hormones. Dysbiosis significantly elevated the hepatotoxicity, pro-inflammatory cytokines, and HMGB1 levels in serum, while significantly decreasing reproductive hormone levels ($p < 0.05$) compared to the control group. Genes related to spermatogenesis were significantly upregulated after treatment ($p < 0.05$). ASH treatment markedly reduced inflammation caused by dysbiosis and helped restore hormonal balance. It also improved sperm quality and fertility competence. These results demonstrate that ASH effectively restores reproductive function impaired by dysbiosis by lowering oxidative stress and inflammation, highlighting its potential as a therapeutic agent for male infertility.

Key words : dysbiosis, Ashwagandha, testis, inflammation, spermatogenesis

Analysis of effects of feeding systems and body condition score on serum metabolic profiles and pregnancy rate in Hanwoo cows

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This study investigated the effects of feeding systems and body condition score (BCS) on serum metabolic profiles and pregnancy rates in 590 Hanwoo cows from Hoengseong-gun and the Hanwoo Research Center at Pyeongchang-gun. Cows were monitored from May to July, including repeat breeding, with blood samples collected in September to evaluate metabolic status. The high BCS (4.0–5.0) group showed a significantly lower pregnancy rate (61.2%) than the low (74.5%) and medium (74.4%) groups ($p < 0.05$). The TMR group had higher BCS (3.1 ± 0.7 vs. 2.6 ± 0.8), albumin (3.4 ± 0.2 vs. 3.2 ± 0.2 g/dL), and total cholesterol (147.8 ± 30.8 vs. 116.7 ± 20.4 mg/dL) than the separate feeding group ($p < 0.05$). Blood urea nitrogen (BUN) was also markedly higher in the TMR group (18.0 ± 3.1 mg/dL), suggesting high metabolic concentration. Non-pregnant cows exhibited higher ALT (24.6 ± 5.2 U/L) and BUN (15.2 ± 4.3 mg/dL) than pregnant cows ($p < 0.05$). Specifically, non-pregnant cows in the TMR group showed elevated AST (68.9 ± 21.4 U/L) and phosphorus (6.9 ± 0.9 mg/dL). These findings suggest that maintaining optimal BCS and monitoring nitrogen metabolism are critical for enhancing reproductive efficiency in Hanwoo cows.

Key words : body condition score, feeding system, Hanwoo, pregnancy rate, serum metabolic profiles

Association between microplastic-induced gut dysbiosis and testicular dysfunction in mammals

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Male reproductive dysfunction, characterized by impaired spermatogenesis and reduced sperm quality, is closely associated with immune and inflammatory dysregulation. In this context, microplastics (MPs) have emerged as a potential environmental factor contributing to these effects, possibly through the induction of gut dysbiosis; however, the underlying mechanisms remain poorly understood. Therefore, this study investigated the impact of MP-induced dysbiosis on reproductive function and inflammatory signaling in male mice. Five groups were used: control, 0.5 μm low (100 $\mu\text{g/L}$; 0.5L), 0.5 μm high (1,000 $\mu\text{g/L}$; 0.5H), 50 μm low (100 $\mu\text{g/L}$; 50L), and 50 μm high (1,000 $\mu\text{g/L}$; 50H). MPs were administered via drinking water for 8 weeks, followed by serum, testis, and fecal analysis. MP exposure increased hepatotoxicity markers and pro-inflammatory cytokines (IL-1 β , IL-6, TNF- α), with the greatest changes in the 0.5H group ($p < 0.05$). Reproductive performance declined, as shown by reduced sperm motility, count, and mating ability, particularly in 0.5H. Testicular expression of inflammatory mediators (TLR4, RAGE, HMGB1, TIRAP, IRAK1, RelA) and macrophage markers (CD68, F4/80, CD14), along with calprotectin proteins (S100A8/A9), were significantly elevated. Fecal analysis confirmed gut dysbiosis. Overall, smaller particle size and higher concentration enhanced inflammation via the gut–testis axis, leading to impaired reproductive function.

Key words : dysbiosis, microplastics, testis, inflammation, spermatogenesis

흑염소 암·수 합사 방법에 따른 번식 특성 분석

남철환, 최재은, 최영선, 구민정, 노유진

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흑염소 자연교배 합사 기준은 정립되어 있지 않아 농가별 사육 규모와 환경에 따라 다양하게 운영되고 있다. 이에 본 연구는 선도농가 설문조사를 바탕으로 암컷 25두당 수컷 1두를 기준으로 설정하고, 암컷 25두당 수컷 1두 처리구와 암컷 50두당 수컷 2두 처리구를 비교하여 번식 성적을 분석하였다. 시험 결과, 암컷 50두당 수컷 2두 처리구의 첫 발정주기 수태율은 91%로 암컷 25두당 수컷 1두 처리구(75%)보다 16% 높았고, 평균 산자수도 2.3두로 0.2두 많았다. 농장 현장실증에서도 첫 발정주기 수태율은 각각 90%와 76%로 14% 높게 나타났고, 평균 산자수는 각각 2.6두와 2.5두로 유사한 경향을 보였다. 이는 수컷을 2두 이상 합사할 경우 개체별 교배 능력 차이나 일시적인 체력 저하를 상호 보완할 수 있으며, 교배 기회가 분산되어 전체 수정 성공률 향상에 긍정적으로 작용할 수 있음을 시사한다. 또한 복수의 수컷이 존재할 경우 발정이 집중되는 시기에도 교배 실패 가능성을 줄여 번식 성적의 안정성을 높이는 데 유리할 것으로 판단된다. 암컷 24두에 발정동기화 처리 후 수컷 1두와 자연교배한 결과 첫 발정주기 수태율은 45%로 나타나, 발정 집중 시 단일 수컷의 교배 능력에는 물리적·생리적 한계가 있을 가능성을 확인하였다. 이상의 결과는 자연교배 시 일정 규모 이상의 암컷 집단에서는 수컷 2두 이상을 합사하는 방식이 수태율 향상과 번식 성적 안정화에 효과적일 수 있음을 시사한다.

Key words : 흑염소, 자연교배, 합사방법, 수태율

한우 번식우의 임신 유무와 혈중 대사체 농도의 관계

도한울, 김용환, 손준규, 이명숙, 진실, 강성식

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본 연구는 한우 번식우의 임신 여부와 혈중 대사체의 연관성을 탐색하고, 수태 예측을 위한 후보 지표를 도출하고자 수행되었다. 한우연구센터의 번식우 90두를 본 연구에 공시하였고, 인공수정 후 약 130일에 경정맥에서 혈액을 채취하였다. 이후 직장검사법을 통해 임신 여부를 확인한 결과, 임신우는 60두, 비임신우는 30두로 분류되었다. 전체 90두를 대상으로 혈액 생화학 성분과 혈중 레티놀 농도를 분석하였으며, 이 중 19두(임신 10두, 비임신 9두)에 대해서는 가스크로마토그래피-질량분석기를 이용하여 아미노산 및 유기산을 정량 분석하였다. 번식우 90두의 혈액 생화학 성분 및 레티놀 농도에 대한 개별 로지스틱 회귀분석을 수행한 결과, 임신 여부와 유의한 관련성을 보인 변수는 확인되지 않았다. 번식우 19두 자료에서도 개별 로지스틱 분석에서는 유의한 단일 대사체가 확인되지 않았으나, 단계적 변수선택을 통해 류신과 티로신이 최종 후보 변수로 도출되었다. 이후 2변수 모형에 대해 Firth 보정 로지스틱 회귀분석을 적용한 결과, 류신은 임신 odds 증가와 관련되었고($OR = 1.12$, 95% $CI = 1.03-1.29$, $p < 0.001$), 티로신은 임신 odds 감소와 관련되었다($OR = 0.80$, 95% $CI = 0.59-0.95$, $p < 0.001$). 최종 모형은 전체적으로 유의하였으며($p < 0.001$), leave-one-out cross-validation 결과 AUC 0.82, 정확도 84.2%, 민감도 80.0%, 특이도 88.9%를 나타내어 비교적 양호한 내부 판별 성능을 보였다. 이상의 결과는 류신과 티로신이 번식우의 임신 여부를 반영하는 잠재적 혈중 후보 지표일 가능성을 시사하나, 아미노산 분석 대상이 19두로 제한된 탐색적 결과이므로 향후 더 많은 개체를 대상으로 한 추가 검증이 필요하다.

Key words : 번식우, 임신율, 대사체

Narciclasine induces apoptosis in canine osteosarcoma cells via ROS-mediated mitochondrial dysfunction

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Canine osteosarcoma is a highly malignant tumor with limited treatment options due to chemotherapy resistance and adverse effects. While Narciclasine (NAR) has shown anticancer activity in various human cancers, its efficacy in canine OSA remains unexplored. This study investigated the anticancer effects of NAR on D17 and DSN cells. In our results, NAR treatment significantly reduced cell viability and induced G2 phase arrest in a concentration-dependent manner. Also, through flow cytometry analysis, we confirmed that NAR caused apoptotic cell death and decreased both cytosolic and mitochondrial Ca^{2+} levels. Moreover, NAR induced the collapse of the mitochondrial membrane potential and excessive generation of reactive oxygen species (ROS). Therefore, NAR might induce apoptosis in canine osteosarcoma cells by triggering mitochondrial dysfunction and disrupting intracellular homeostasis.

Key words : narciclasine, osteosarcoma, ROS, mitochondria, calcium flux

Immunomodulatory ability of porcine peripheral blood-derived mesenchymal stem cells

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Mesenchymal stem cells (MSCs) have been reported as promising candidates for modulating immune responses and promoting immune tolerance. Specifically, bone marrow-derived MSCs (BM-MSCs) have demonstrated significant immunomodulatory capabilities, however, obtaining BM-MSCs remains challenging due to its invasive nature. As an alternative, peripheral blood-derived MSCs (PB-MSCs) can be harvested through a minimally invasive method, however, their characterization and immunomodulatory function remain poorly understood. In this study, PB-MSCs isolated from peripheral blood mononuclear cells (PBMCs) of healthy porcine donors expressed MSC markers CD44, CD73, CD90, and CD105, while lacking hematopoietic markers CD11b and CD45, with comparable multi-lineage differentiation potential to BM-MSCs. Human monocyte-derived M1-like macrophages were indirectly co-cultured with MSCs. As a result, PB-MSCs more effectively suppressed pro-inflammatory cytokines IL-1 β , TNF- α , and IL-6, enhanced anti-inflammatory IL-10, and promoted M2 macrophage polarization compared to BM-MSCs. These findings suggest that porcine PB-MSCs possess robust immunomodulatory capacity, which may contribute to modulating the maternal immune environment during reproduction in porcine.

Key words : peripheral blood-derived mesenchymal stem cells (PB-MSCs), immune-modulation, macrophage polarization, xenotransplantation, CD73, adenosine signaling

Preliminary evaluation of *in vitro* embryo development using sex-sorted Jersey semen compared with conventional Hanwoo embryo production

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As the utilization of Jersey cattle in the Korean dairy industry increases, the use of sex-sorted semen for securing superior female calves has gained attention. However, information regarding *in vitro* embryo production (IVP) using Jersey sex-sorted semen remains limited in Korea. Therefore, this study evaluated embryo development using Jersey sex-sorted semen and compared the results with conventional Hanwoo IVP data. Jersey ovary-derived oocytes were subjected to *in vitro* maturation (IVM), *in vitro* fertilization (IVF), and *in vitro* culture (IVC). Embryonic development was evaluated at the 2-cell, 8–16 cell, and morula-blastocyst stages. In Hanwoo embryo production, morula-blastocyst development rates were 27.3%, 40.0%, and 52.0%, respectively, whereas Jersey sex-sorted semen-derived embryos showed development rates of 28.6%, 33.3%, and 32.6%, respectively. Normal embryonic development to the morula-blastocyst stage was observed in the Jersey groups. These results demonstrate that IVP using Jersey sex-sorted semen is feasible and may provide preliminary data for securing female Jersey calves and expanding the reproductive foundation of Jersey cattle in Korea.

Key words : Jersey, sex-sorted semen, *in vitro* embryo production (IVP), Hanwoo, blastocyst development

Effects of heat stress on motility of dairy bull frozen-thaw Jersey and Holstein spermatozoa

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The decline in artificial insemination efficiency of dairy cattle during hot seasons is reportedly more severe in Holstein than in Jersey cows. Given that cow body temperatures can reach up to 41.5°C under extreme heat, this study evaluated the reduction in sperm motility under induced heat stress using Jersey and Holstein bull spermatozoa. The motile sperm was isolated with Percoll gradient method from the frozen straws of four Jersey and three Holstein bulls. Following incubation in BO medium at 41.5°C for 1, 3, and 6 hours, sperm motility was assessed by CASA system. Holstein sperm motility rapidly decreased to 45.2% at 1 hour, 15.7% at 3 hours, and 3.5% at 6 hours. In contrast, Jersey sperm maintained higher motility at 85.2%, 52.6%, and 32.5% at 1, 3, and 6 hours, respectively. These results demonstrate that the impaired summer fertility of Holstein cows is primarily due to the inherent thermal vulnerability of their spermatozoa, highlighting the need for future studies to improve sperm longevity.

Key words : dairy bull semen, heat stress, motility, Holstein, Jersey

Antifreezing gold colloids rescue developmental competence after bovine blastocyst vitrification

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Bovine *in vitro*-produced (IVP) embryos are valuable resources for genetic preservation, embryo transfer, and reproductive biotechnology. However, cryopreservation remains limited by cryo-warming injury caused by osmotic imbalance, cryoprotectant-associated toxicity, oxidative stress, cellular structural disruption, and ice crystallization- or recrystallization-associated physical damage. Although vitrification minimizes ice crystal formation by inducing a glass-like state, insufficient stability during warming may impair membrane integrity, cytoskeletal organization, and trophectoderm function, reducing developmental competence. This study evaluated whether threonine-functionalized gold nanoparticles (AuNPs) could mitigate cryo-warming injury in bovine IVP blastocysts. AuNP physicochemical properties and stability in vitrification- and warming-related media were assessed. Bovine IVP blastocysts were assigned to control and AuNP-treated groups, vitrified, warmed, and evaluated for morphological survival, re-expansion, developmental progression, and degeneration. Cellular and molecular assessments related to oxidative stress, apoptosis, cytoskeletal stability, and trophectoderm integrity were further performed. This study provides an integrated evaluation of AuNP-based cryoprotection as a physical and chemical strategy to improve bovine embryo cryopreservation.

Key words : bovine IVP embryo, vitrification, gold nanoparticle, cryopreservation, developmental competence

Hematological and metabolic responses of Hanwoo calves to early and conventional weaning

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This study evaluated the effects of weaning age on growth performance and physiological adaptation in Hanwoo calves under natural suckling conditions. Calves were assigned to either a 60-day (W60) or 90-day (W90) weaning group, and hematological and serum biochemical parameters were analyzed before and after weaning. No significant differences were observed in body weight or average daily gain between groups. However, calves in the W60 group showed greater alterations in hematological and metabolic parameters after weaning. Hematocrit, hemoglobin-related indices, glucose, calcium, and total cholesterol transiently decreased following weaning, with more prolonged changes observed in W60 calves. In contrast, AST, ALT, and BUN remained within normal physiological ranges. These findings suggest that early weaning at 60 days does not impair growth performance but may increase physiological adaptation stress compared with conventional weaning at 90 days. The results indicate that evaluation of weaning strategies should consider both growth and metabolic adaptation responses in calves.

Key words : Hanwoo calf, weaning age, hematology, metabolism, adaptation stress

Integrated analysis of subclinical endometritis, uterine microbiota dysbiosis, and conception rate in dairy heifer

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Reduced reproductive efficiency in dairy cattle causes substantial economic losses, and subclinical endometritis (SCE) is difficult to diagnose due to the absence of overt symptoms. While most studies have examined multiparous cows, research on SCE in heifers remains limited. Early detection in the heifer stage may enable a healthy transition to breeding and improve conception. This study investigated eight dairy heifers to explore associations among uterine polymorphonuclear neutrophil percentage (PMN%), inflammatory markers (IL-6, TNF- α , and IL-1 β), hematological indices (CBC), uterine microbiota (16S rRNA-based microbiota profiling) and embryo transfer (ET) pregnancy outcome. Heifers with PMN% $\geq$ 5% were classified as SCE, whereas those with PMN% $<$ 5% were classified as healthy controls (HC). The SCE group showed higher PMN% and a higher mean IL-6 level, while TNF- α and IL-1 β were below the detection limit in all samples. CBC results showed no significant group differences. At the phylum level, The SCE group was enriched in potentially pathogenic taxa such as *Pseudomonadota*, while the healthy cow (HC) group was dominated by *Bacillota* and *Bacteroidota* with greater microbial diversity. Pregnancy rates were markedly reduced in the SCE group. The integrated results support an exploratory heifer SCE assessment framework linking PMN%-based grouping, IL-6 elevation, uterine microbiota shifts, and reduced ET pregnancy outcome, with validation in larger cohorts required.

Key words : dairy heifers, subclinical endometritis, polymorphonuclear neutrophils, inflammatory cytokines, uterine microbiota

Runs of homozygosity analysis reveals candidate genomic regions underlying spontaneous abortion in Hanwoo

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Spontaneous abortion causes significant economic losses and welfare concerns in cattle populations on a global scale. Hanwoo (*Bos taurus coreanae*) has formed a population with limited genetic diversity due to geographic isolation and breed conservation policies, including the intensive use of artificial insemination from a minority of elite sires. This is likely to elevate inbreeding levels in the population and facilitate the spread and homozygous expression of recessive lethal alleles, potentially contributing to increased rates of spontaneous abortion. To investigate the genetic mechanisms underlying abortion in Hanwoo, we performed whole-genome sequencing-based analysis on 112 aborted fetuses. We identified 37 shared ROH regions with lengths ≥ 1 Mb, 274 regions with lengths ≥ 500 kb, and 277 regions using a 500 kb sliding-window approach in more than 30% of aborted fetuses across all autosomes. Gene annotation revealed several candidate genes, including *SILI*, *LRRTM2*, and *ENO1*. *LRRTM2* is expressed in neural tube during embryo development. *ENO1* primarily suppressed the growth and invasion of villous trophoblasts. The significantly shared genes identified in the genomes of aborted fetuses were associated with placental development, chorionic membrane function, and fetal neural development. To clarify the precise mechanisms underlying their potential roles in fetal viability, future analyses will leverage the sire-dam-offspring trio structure to perform *de novo* mutation detection, which may reveal additional genetic risk factors underlying spontaneous abortion in this isolated breed.

Key words : runs of homozygosity, spontaneous abortion, Hanwoo

Associations of mating body weight and lactation feed intake with reproductive performance and piglet growth in gilts

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This study was conducted to investigate the associations of mating body weight (MBW) and total lactation feed intake (LFI) with reproductive performance and piglet growth performance in gilts. A total of 679 PIC-breed gilts were included, and data on MBW, LFI, weaning-to-estrus interval (WEI), total born, born alive, stillborn piglets, birth weight, piglet weaning weight, and average daily gain (ADG) were collected. Spearman's rank correlation analysis was used to examine associations between MBW or LFI and reproductive and piglet performance. Each variable was divided into five quintile-based groups (T1–T5), and differences among groups were assessed using one-way analysis of variance (ANOVA). Spearman's Correlation analysis showed that total born was positively correlated with MBW ($r = 0.128$, $p = 0.012$). Piglet weaning weight ($r = 0.259$, $p < 0.001$) and ADG ($r = 0.246$, $p < 0.001$) were both positively correlated with LFI. In the quintile-based group comparisons, gilts in the highest MBW group (T5, > 159 kg) had significantly higher total born. However, the number of stillborn piglets was significantly higher in the T5 group ($p < 0.05$). Gilts in the highest LFI group (T5, > 125 kg) showed significantly higher piglet weaning weight and ADG compared to the other groups ($p < 0.001$). These findings suggest that securing an optimal MBW and ensuring adequate feed intake during lactation may contribute to improved reproductive and piglet performance in gilts. However, excessively high MBW may be accompanied by increased stillbirth, highlighting the importance of managing body weight within an appropriate range.

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Key words : sow, body weight, feed intake, reproductive performance, piglet

한우 생체 난소 내 난자 생검 기술 활용 분만 유래 거세우 도체 성적에 관한 연구

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본 연구는 전남지역 농가를 대상으로 우량 한우 사육기반 조성을 위해 생체 난소 내 난자 생검(OPU) 기술을 활용하였다. 수정란 생산을 위해 우수 한우 암소를 활용하여 초음파 영상장비를 활용한 OPU 기술로 채취된 난자를 활용하여 체외발달 및 체외수정 배양 등을 걸쳐 수정란을 생산하였다. 이식 가능한 수정란을 발정관찰이 확인되고, 난소 내 황체 형성이 양호한 대리모에 이식하여 송아지를 생산하였다. 이식 후 분만된 수송아지는 6~8개월령에서 거세를 실시한 다음 육성 후 비육을 실시하였고 생후 30개월령 내외에 도축을 실시하였다. 도축된 거세우 65두의 출하 성적을 조사한 결과, 육질의 경우 1++등급 34두(52.3%), 1+등급 20두(30.8%), 1등급 9두(13.8%), 2등급 2두(3.1%)로 조사되었다. 65두의 평균 도체중은 509kg으로 한우 OPU 기술 유래 거세우의 도체중이 일반 인공수정 유래 거세우 대비 다소 높은 것으로 조사되었다. 본 연구 결과를 바탕으로 고능력 암소와 적절한 씨수소 교배조합을 통한 우량 수정란 이식을 지속적으로 추진한다면 한우 농가의 출하소득 향상과 개량 가속화에 기여가 가능할 것으로 사료된다.

Key words : 한우, OPU, 수정란, 도체중, 거세우

Effect of recipient age in months on conception rate in Hanwoo OPU-derived embryo transfer

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In vitro cultured fertilized eggs produced by *in vivo* ovarian oocyte biopsy technology are a technology that is very useful for improving Hanwoo cattle and for preserving and propagating the genetic resources of the native livestock Chikso. Recently, the production of *in vitro* fertilized Hanwoo embryos following live oocyte biopsy using ultrasound imaging equipment is actively underway in Korea through relevant institutions, universities, and private companies. The greatest advantage of embryo transfer technology is that it can accelerate the rate of improvement through the simultaneous use of high-performance male and female cattle, and expand the scope of utilization for high-performance female cattle when using *in vivo* ovarian oocyte biopsy technology. To expand embryo transfer, it is necessary to improve the management techniques of recipient cows to address the disadvantage of low conception rates. Accordingly, in this study, we investigated the conception rate according to the age of the recipient cows to utilize the findings for conducting related research aimed at improving the conception rate following the transplantation of Hanwoo embryos derived from live oocyte biopsy. A total of 217 animals were tested for conception rates, and the results showed 32.1% for 12–36 months of age, 45.5% for 37–60 months of age, 31.3% for 61–84 months of age, and 42.1% for 85–108 months of age.

Key words : embryo transfer, OPU, conception rate, feeding and management

Effects of sow-specific pheromone on body weight gain in weaned pigs

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Maternal olfactory cues are associated with reduced stress-related behaviors and improved adaptation in newly weaned pigs. This study evaluated whether a sow-specific volatile compound identified by GC-MS-TOF analysis could improve nursery growth performance when delivered as wax-based olfactory enrichment blocks under commercial conditions. Three independent room trials were conducted using sequential batch designs in which untreated control groups preceded treated groups within identical facilities. Rooms differed in target scent concentration and spatial allowance: Room 1 (low concentration; 0.130 vs 0.131 m²/head), Room 2 (medium; 0.174 vs 0.168 m²/head), and Room 3 (high; 0.129 vs 0.121 m²/head for control and treatment, respectively). Pigs were stratified by weaning body weight into weight classes ($p < 0.001$). Nursery body weight gain was analyzed separately by room using general linear models including Group, Time, Weight Class, Sex, and their interactions. Body weight increased over time in all rooms ($p < 0.001$), but no significant Group $\times$ Time interaction was detected in Room 1 (3.61 ± 0.22 vs 3.67 ± 0.10 kg, $p = 0.967$), Room 2 (4.95 ± 0.13 vs 4.89 ± 0.13 kg, $p = 0.748$), or Room 3 (5.01 ± 0.10 vs 5.24 ± 0.10 kg, $p = 0.120$). However, a significant Group $\times$ Weight Class $\times$ Time interaction was identified in Room 3 ($p = 0.004$), where treated pigs in heavier weight classes exhibited greater body weight gain despite reduced spatial allowance, including Weight Class 3 (5.33 ± 0.21 vs 5.01 ± 0.21 kg) and Weight Class 4 (6.10 ± 0.20 vs 5.09 ± 0.21 kg). These findings suggest that sow-specific olfactory enrichment may selectively improve nursery growth performance in heavier pigs under high-density conditions, indicating that initial body mass influences responsiveness to maternal scent cues.

Key words : sow-specific scent, weaned pigs, volatile exposure, body weight change, growth performance, size-dependent response

Effectiveness of an ovarian ultrasonography centric practical training program for Hanwoo embryo transfer technicians

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With the expanding field application of Ovum Pick-Up (OPU) derived *in vitro* embryo production (IVP) and the growing need for precise selection of donor and recipient cows, securing skilled embryo transfer (ET) technicians has become increasingly important. Because ET conception rates are primarily determined by three factors—(1) the condition of the cow and farm environment, (2) embryo quality, and (3) the operator's skill and experience—targeted improvements in technician competency are essential to enhance overall reproductive outcomes. This study evaluated the efficacy of a novel training protocol that prioritizes ovarian and ultrasonographic examinations, diverging from the conventional pedagogical sequence that typically begins with artificial insemination (AI). Four undergraduate students participated in an intensive, two-month training program at the Jeonnam National University Naju Experimental Farm using six dairy cows. Trainees first prioritized ovarian examination and ultrasonography, followed by pregnancy diagnosis, AI, and OPU. Ovarian and cervical palpation were practiced daily. OPU sessions were performed every two weeks during a subsequent one-year follow-up period. Technical competency was quantitatively assessed by measuring diagnostic accuracy and procedural success rates at each stage (reported as Mean $\pm$ SD). Upon completion of the program and the one-year follow-up OPU practice, all trainees demonstrated high proficiency in ovarian ultrasonography, with a mean interpretation accuracy of $85.0 \pm 2.9\%$. Pregnancy diagnosis accuracy reached $75.0 \pm 2.9\%$. The procedural success rate for ET and AI attempts was $82.5 \pm 4.8\%$. Through OPU practice conducted every two weeks over the following year, all trainees achieved an oocyte recovery rate of $51.3 \pm 8.3\%$, consistent with field-ready proficiency. In resource-limited training environments, prioritizing ovarian examination and ultrasonographic training—followed by sustained, periodic OPU practice—can effectively shorten the time required to achieve technical proficiency. Early intensive training utilizing ultrasound systems equipped with vaginal probes, combined with regular OPU practice every two weeks for one year, represents an efficient model for cultivating specialists in large animal reproduction.

Key words : embryo transfer, training protocol, ovarian ultrasonography, ovum pick-up, Hanwoo