Los antioxidantes y la eficiencia reproductiva

Alrededor de 2% del oxígeno utilizado por el metabolismo animal se convierte en especies reactivas de oxígeno entre las que se encuentran los iones de oxígeno, los radicales libres y los peróxidos; tales moléculas, son removidas por varios sistemas bioquímicos presentes en las células y en los fluidos extracelulares conocidos como antioxidantes. La producción excesiva de moléculas oxidantes y la deficiencia de sustancias antioxidantes conducen a su acumulación y al daño celular, a esto se le denomina estrés oxidante. La acumulación de especies reactivas de oxígeno puede ser una causa de la baja eficiencia reproductiva debido a que afectan la síntesis de hormonas esteroides, la tasa de fertilización y el desarrollo temprano del embrión. En el grupo de los antioxidantes se encuentran el Selenio, la vitamina E y los β-Carotenos; no obstante que están presentes en las dietas de los bovinos, la administración exógena de estos antioxidantes sea oral o intramuscular mejora el desempeño reproductivo. Las vacas lecheras de alta producción necesitan mayor cantidad de sustancias antioxidantes debido a que es mayor su metabolismo oxidativo debido al elevado consumo de energía metabolizable necesario para la síntesis y secreción de la leche, así como para su mantenimiento. En pruebas de campo la complementación de Selenio y vitamina E en vacas lecheras antes y después del parto disminuye las patologías del puerperio y mejora la fertilidad; mientras que su administración en vacas superovuladas mejora la calidad embrionaria. Asimismo, la inclusión de β-Carotenos en la dieta tiene un efecto positivo en la fertilidad de las vacas bajo estrés calórico. No se debe olvidar que algunos tratamientos pueden ser exitosos en ciertas condiciones pero no funcionan de la misma forma en otras condiciones, por tanto, es importante evaluar cualquier tratamiento antes de imponerlo como una práctica rutinaria.

Estimados amigos, el aumento de la eficiencia reproductiva requiere del mejoramiento de todas las prácticas de manejo, dentro de las cuales, la complementación con antioxidantes es una opción más.

Dr. Joel Hernández Cerón
Compilador
Departamento de Reproducción
Incidencia de patologías uterinas y fertilidad de vacas Holstein tratadas con selenio y vitamina E antes y después del parto

Incidence of uterine pathologies and fertility of Holstein cows treated with selenium and vitamin E before and after parturition

Luis Alonso Ruiz Juárez* Oscar Ortiz González Carlos F. Aréchiga Flores Carlos G. Guillérez Salvador Morales Roura Joel Hernández Cerón

Abstract

An antioxidant treatment based on vitamin E and selenium subcutaneously (sc) injections administered prior to and after parturition, was evaluated by measuring the incidence of uterine pathologies and fertility in lactating Holstein cows. Cows (n = 353) were randomly distributed into three groups: Group pre-postpartum (n = 122), cows received a sc injection of 50 mg Se and 680 IU vitamin E (10 mL of Mu-Se) on 60 and 21 days prepartum and 30 and 90 days postpartum; Group prepartum (n = 114) received a sc injection 21 days prior to parturition; control Group (n = 117), cows received sc injections of saline solution (55.10 mL) on 60 and 21 days prepartum and 30 and 90 days postpartum. Incidence of retained fetal membranes (RFM) in control Group (20.1%) was similar (P>0.05) to prepartum Group (12.8%), but it differed (P<0.05) from pre-postpartum Group (6.5%). The percentage of cows with haemorrhagic metritis (HM) was similar among groups (8.7%; P>0.05). Proportion of cows with purulent metritis (PM) in control Group (37.7%) was similar (P>0.05) to prepartum Group (33.3%), but reduced (P<0.05) in pre-postpartum Group (23.7%). The global proportion of cows showing any of the evaluated pathologies was similar (P>0.05) for control groups (44.7%) and prepartum Group (40.1%) but lower (P<0.05) for pre-postpartum Group (27%). Pregnancy rate at 150 days postpartum (PP) was greater (P<0.08) for pre-postpartum Group (70%) than control Group (58.9%). In conclusion, an antioxidant therapy based on vitamin E and selenium administration, 60 and 21 days prior to parturition and 30 and 90 days after parturition, reduces the incidence of uterine pathologies and improves pregnancy rate at 150 days postpartum in Holstein cows.

Key words: SELENIUM, VITAMIN E, METRITIS, FERTILITY, DAIRY CATTLE.

Resumen

Se evaluó el efecto de una terapia antioxidante basada en inyecciones de selenio y vitamina E, administradas antes y después del parto, en la incidencia de patologías uterinas y fertilidad en vacas Holstein. Se utilizaron 353 vacas, las cuales se asignaron al azar a tres grupos: Grupo pre-posparto (n = 122), las vacas recibieron una inyección sc de 50 mg de selenio y 680 UI de vitamina E (10 mL de Mu-Se) los días 60 y 21 preparto y 30 y 90 posparto; Grupo posparto (n = 117), las vacas recibieron una inyección similar al grupo anterior 21 días antes del parto; Grupo testigo (n = 114), los animales recibieron una inyección subcutánea de 10 mL de solución salina fisiológica los días 60 y 21 preparto, y 30 y 90 posparto. La incidencia de retención placentaria en el Grupo testigo (20.1%) fue similar (P>0.05) al Grupo preparto (12.8%), pero difirió (P<0.05) del Grupo pre-posparto (6.5%). La proporción de vacas con metritis hemorrágica fue similar entre grupos (8.7%; P>0.05). El porcentaje de vacas con metritis purulenta en el Grupo testigo (37.7%) fue igual (P>0.05) al Grupo preparto (33.3%), pero se redujo (P<0.05) en el Grupo pre-posparto (23.7%). La proporción global de vacas con cualquiera de las patologías evaluadas fue similar (P>0.05) entre las vacas de los grupos testigo (44.7%) y preparto (40.1%), pero fue menor (P<0.05) en el Grupo pre-posparto (27%). El Grupo pre-posparto tuvo mayor (P<0.08) tasa de gestación (70%) a los 150 días posparto que el testigo (58.9%). Se concluye que la administración de selenio y vitamina E los días 60 y 21 antes del parto y 30 y 90 posparto, reduce las patologías uterinas y mejora la tasa de gestación a los 150 participantes en vacas Holstein.

Palabras clave: SELENIUM, VITAMINA E, METRITIS, FERTILIDAD, GANADO LECHEIRO.
Use of a novel surgical approach to manage macerated fetus in a crossbred cow

P. Sood, N. K. Vasishta, M. Singh
Department of Animal Reproduction, Gynecology and Obstetrics, College of Veterinary and animal Sciences, CSK Himachal Pradesh Agricultural University, Palampur 176062, India

AMONG farm animal species, fetal maceration has been described most frequently in cows. Incomplete abortion after the third month of gestation is the main reason for a retained fetal bony mass in the uterus of cows (Long 2001). The available literature describes surgical treatment as difficult, a poor prognosis and a low likelihood of successful future pregnancy (Roberts 1986), or even slaughter (Long 2001), for cows with fetal maceration. This short communication describes the surgical removal of a macerated fetus through the gluteal region in a cow that subsequently conceived.

* Corresponding author: psoodhjpkv@yahoo.com

How to Evaluate and Quantify the Influence of Coincidence on Fertility and Herd Health Parameters? A Practical Overview of Frequently Used and Abused Statistical Techniques in Research and Practice

J. Dewulf, D Maes, A Van Soom and A de Kruif
Veterinary Epidemiology Unit, Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

In this article, frequently encountered statistical questions and methods used both in research and in daily practice are described and explained. First, the concepts of variability and uncertainty are explained and illustrated. From this, it is explained how variation can be quantified and how the limits of what can be expected as a result of normal variation are determined both for continuous and binary data. Based on the basic concepts of probability theory, an introduction to risk assessment was given. Finally it is explained how to test whether individual observations lie outside the normal range or the test whether populations are different from each other. All these are carried out avoiding theory and formulas as much as possible and illustrated with real examples from reproduction and herd health.

Author's address Jeroen Dewulf, E-mail: jeroen.dewulf@ugent.be

Associations among patterns in daily body weight, body condition scoring, and reproductive performance in high-producing dairy cows

M. van Straten*, L, N. Y. Shpigel and M. Friger†
* "Hachaklait," Mutual Society for Veterinary Services, POB 3039, Caesarea Industrial Park 38900, Israel
† Koret School of Veterinary Medicine, Faculty of Agriculture, Hebrew University of Jerusalem, POB 12, Rehovot 76100, Israel
‡ Department of Epidemiology and Health Service Evaluation, Faculty of Health Sciences, Ben-Gurion University of the Negev, POB 653, Beer Sheva 84105, Israel

The objective was to investigate the associations between body condition scores (BCS) and daily body weight (BW) in the first 150 d of lactation (DIM) and reproductive performance in high-producing dairy cows. Data included automated daily BW measurements and BCS of 2,020 Israeli Holstein cows from 7 commercial farms. Individual BW series were smoothed using penalized cubic splines, and variables representing BW patterns were generated. The presence of 7- and 21-d cycles in BW was determined using time-series analysis. Associations between BW and BCS and conception at first artificial insemination (AI) were analyzed using generalized estimating equations. Multivariate survival analysis was used for associations between BW and BCS and the calving-to-first AI interval, first AI-to-conception interval, and calving-to-conception interval. First-parity cows that lost 12% and second-parity cows that lost 15% of their BW from calving to nadir BW were less likely to conceive at first AI. Cows without 7-d cycles in BW were 1.48 times more likely to conceive at first AI relative to cows with 7-d cycles. The odds of conceiving at first AI increased by 53% for each additional unit in BCS from 40 to 60 DIM. In the multivariate survival analysis, a BCS of 2.5 between 40 and 60 DIM,
the percentage of BW lost from calving to nadir BW, and a BW loss of 7% from calving to 10 DIM were associated with reduced reproductive performance. The presence of 21-d cycles in BW was associated with high reproductive performance in first-parity [odds ratio (OR) = 1.18] and second-parity cows (OR = 1.22). The presence of 7-d cycles in BW was associated with low reproductive performance in first-parity cows (OR = 0.77), but not in older cows. Based on previous findings and on the associations found in this study, we postulate that 21-d cycles are probably related to the sexual cycle and could be used as a proxy for assessing ovarian activity. Variables representing relative BW loss (%) were better predictors for impaired reproductive performance than those representing absolute BW loss (kg) and may be more suitable for estimating individual adaptation to negative energy balance in herds for which automated daily BW is available.

1 Corresponding author: chkl351@netvision.net.il


Comparison of long-term CIDR-based protocols to synchronize estrus in beef heifers

N.R. Leitman*, D.C. Busch†, D.A. Mallory†, D.J. Wilson‡, M.R. Ellersieck¶, M.F. Smith†, D.J. Patterson*,*

Division of Animal Science, University of Missouri, Columbia, S132 ASRC, 920 E. Campus Dr., Columbia, MO 65211, USA

Agricultural Experiment Station, University of Missouri, Columbia, 146 MDLBH, Columbia, MO 65211, USA

Two experiments evaluated long-term controlled internal drug release (CIDR) insert-based protocols to synchronize estrus and compare differences in their potential ability to facilitate fixedtime artificial insemination (FTAI) in beef heifers. In Experiment 1 estrous cycling heifers (n = 85) were assigned to one of two treatments by age and bodyweight (BW). Heifers with T1 received a CIDR from days 0 to 14, gonadotropin releasing hormone (GnRH) on day 23, and prostaglandin F2α (PG) on day 30. Heifers with T2 received a CIDR from days 2 to 16, GnRH on day 23, and PG on day 30. Ovaries were evaluated by ultrasonography on days 23 and 25 to determine ovulatory response to GnRH. In Experiment 2 heifers (n = 353) were assigned within reproductive tract scores by age and BW to one of four treatments. Heifers in T1 and T2 received the same treatments described in Experiment 1. Heifers in T3 and T4 received the same treatments as T1 and T2, respectively, minus the addition of GnRH. In Experiments 1 and 2, heifers were fitted with HeatWatch transmitters for estrous detection and AI was performed 12 h after estrus. In Experiment 1 heifers assigned to T1 had larger dominant follicles at GnRH compared to T2 (P < 0.01) but response to GnRH, estrous response after PG, mean interval to estrus, and variance for interval to estrus after PG did not differ (P > 0.10). AI conception and final pregnancy rate were similar (P > 0.50). In Experiment 2 estrous response after PG did not differ (P > 0.70). Differences in mean interval to estrus and variance for interval to estrus (P < 0.05) differed based on the three-way interaction of treatment length, GnRH, and estrous cyclicity status. AI conception and final pregnancy rates were similar (P > 0.10). In summary, the greater estrous response following PG and resulting AI conception and final pregnancy rates reported for heifers assigned to the two treatments in Experiment 1 and among the four treatments in Experiment 2 suggest that each of these long-term CIDR-based protocols was effective in synchronizing estrus in prepubertal and estrous cycling beef heifers. However, the three-way interaction involving treatment length, GnRH, and estrous cyclicity status in Experiment 2 clearly suggests that further evaluation of long-term CIDR-based protocols is required with and without the addition of GnRH and on the basis of estrous cyclicity status to determine the efficacy of these protocols for use in facilitating FTAI.

*Corresponding author. E-mail address: pattersond@missouri.edu
Two experiments were designed to evaluate models for generation of low circulating progesterone concentrations during early pregnancy in cattle. In Experiment 1, 17 crossbred heifers (Bos taurus) were assigned to either prostaglandin F2α (PGF2α) administration on Days 3, 3.5, and 4 (PG3; n = 9) or to control (n = 8). Blood samples were collected from heifers from Days 1 to 9 for progesterone assay. Progesterone concentrations were decreased (P < 0.03) between 18 and 48 h after first PGF2α treatment in heifers assigned to PG3 compared with that of controls. In Experiment 2, 39 crossbred heifers detected in estrus were inseminated (Day 0) and assigned to either (1) PGF2α administration on Days 3, 3.5, and 4 (PG3; n = 10), (2) PGF2α administration on Days 3, 3.5, 4, and 4.5 (PG4; n = 10), (3) Progesterone Releasing Intravaginal Device (PRID) insertion on Day 4.5 with PGF2α administration on Days 5 and 6 (PRID + PGF2 α; n = 10), or (4) control (n = 9). Blood samples were collected daily until Day 15, and conceptus survival rate was determined at slaughter on Day 16. Progesterone concentrations during the sampling period in the PG3 and PG4 groups did not differ but were less than that of controls (P < 0.01). After an initial peak, progesterone concentrations in the PRID + PGF2α group were similar to that of controls. More heifers in the PG4 group (6 of 10) had complete luteal regression than did those in the PG3 group (3 of 10). Conceptus survival rate on Day 16 did not differ between groups. There was a significant correlation between progesterone concentration on Days 5 and 6 and conceptus size on Day 16. In summary, treatment with PGF2α on Days 3, 3.5, and 4 postestrus appeared to provide the best model to induce reduced circulating progesterone concentrations during the early luteal phase in cattle.

* Corresponding author. E-mail address: mark.crowe@ucd.ie
have greater AI pregnancy rates when inseminated at 56 h, whereas older cows had similar pregnancy rates when inseminated at 56 h or later (timing of AI by age interaction; P = 0.085). Pregnancy loss between Days 32 and 63 was greatest (quadratic effect; P < 0.05) when cows were inseminated at 48 and 72 h. In summary, insemination times at or after 56 h improved AI pregnancy rates when using the CO-Synch + CIDR program. Further work is warranted to examine age effects on timing of AI in the CO-Synch + CIDR program.

* Corresponding author: jss@k-state.edu

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Pregnancy outcome after insemination of frozen-thawed bovine semen packaged in two straw sizes: A meta-analysis

J. S. Stevenson*, J. J. Higgins and Y. Jung

* Department of Animal Sciences and Industry, and 1 Department of Statistics, Kansas State University, Manhattan 66506

The 0.25-mL French straw has been thoroughly studied and compared with the 0.5-mL French straw for about 40 yr. The 0.25-mL straw has some distinct advantages over the 0.5-mL straw in terms of storage efficiency and extender usage. The 0.25-mL straw is more sensitive to temperature change, which may be an advantage in some freezing systems with a slow freezing rate, but provides no advantage when the freezing rate is accelerated to optimize freezing in 0.5-mL straws. Disadvantages of the 0.25-mL straw include increased sensitivity to post-thaw temperature change, slightly more difficult handling, and inferior readability. Fertility of cattle inseminated with extended semen packaged in 0.25-mL straws assessed in 13 studies (>770,000 inseminations) had a weighted advantage of 0.9% (0.7% unweighted advantage) compared with semen packaged in 0.5-mL straws. In 2 studies in which palpated conception rates were obtained, the weighted advantage of the 0.25-mL versus the 0.5-mL straw was 0.2% (0.4% unweighted advantage). Paired t-tests did not detect a significant difference in pregnancy outcome between straw sizes. Logistic regression of all 15 studies (>780,000 inseminations) detected large variation among studies and tended to detect a small advantage for the 0.25-mL straw. Meta-analyses applied to fixed- or random-effect models of all 15 studies indicated the average odds of having a greater pregnancy outcome with the 0.25-mL straw were either 3 or 4% greater. Based on these odds ratios, the expected proportion of difference in pregnancy outcome translated into a difference of 0.74%. These small differences in pregnancy outcomes do not provide compelling evidence that a transition from 0.50- to 0.25-mL straws in the United States is warranted, especially given the added negative aspects of semen handling and the greater potential for technician x straw type interactions among herdsman inseminators.

2 Corresponding author: jss@k-state.edu

Mechanisms of Infertility Associated with Clinical and Subclinical Endometritis in High Producing Dairy Cattle

IM Sheldon 1, SB Price 2, J Cronin 3, RO Gilbert 3 and JE Gadsby 2,4

1 Institute of Life Science, School of Medicine, Swansea University, Swansea, UK, 2 Department of Veterinary Clinical Sciences, Royal Veterinary College, London, UK, 3 Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY, USA, 4 Department of Molecular Biomedical Sciences, North Carolina State University College of Veterinary Medicine, Raleigh, NC, USA

Clinical and subclinical endometritis are common causes of infertility and subfertility in high producing dairy cattle, delaying the onset of ovarian cyclic activity after parturition, extending luteal phases and reducing conception rates. Escherichia coli and Arcanobacterium pyogenes cause endometrial damage and inflammation. Components of microbes, such as lipopolysaccharide (LPS), are detected by Toll-like receptors on endometrial cells, leading to secretion of cytokines, chemokines and antimicrobial peptides. Long luteal phases associated with endometritis are probably caused by a switch in endometrial prostaglandin
production from prostaglandin F2α (PGF) to prostaglandin E2. In addition, LPS impairs the function of the hypothalamus and pituitary, and directly perturbs ovarian granulosa cells steroidogenesis, providing mechanisms to explain the association between uterine disease and anovulatory anoestrus. Cows with uterine disease that ovulate have lower peripheral plasma progesterone concentrations that may further reduce the chance of conception associated with endometritis.

Author’s address M Sheldon, E-mail: i.m.sheldon@swansea.ac.uk

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Pregnancy rates and corpus luteum–related factors affecting pregnancy establishment in bovine recipients synchronized for fixed-time embryo transfer


a Federal University of Viçosa, Av. P.H. Rolfs s/n, Viçosa, MG, 36570-000, Brazil
b Embrapa Cerrados, Planaltina, DF, 73310-970, Brazil
c Embrapa Dairy Cattle Research Center, Juiz de Fora, MG, 36038-330, Brazil
d University of Alfenas, Alfenas, MG, 37130-000, Brazil

The objective was to investigate the influence of corpora lutea physical and functional characteristics on pregnancy rates in bovine recipients synchronized for fixed-time embryo transfer (FTET). Crossbred (Bos taurus taurus Bos taurus indicus) nonlactating cows and heifers (n = 259) were treated with the following protocol: 2 mg estradiol benzoate (EB) plus an intravaginal progesterone device (CIDR 1.9 g progesterone; Day 0); 400 IU equine chorionic gonadotropin (eCG; Day 5); prostaglandin F2α (PGF2α) and CIDR withdrawal (Day 8); and 1 mg EB (Day 9). Ovarian ultrasonography and blood sample collections were performed on Day 17. Of the 259 cattle initially treated, 197 (76.1%) were suitable recipients; they received a single, fresh, quality grade 1 or 2 in vivo–derived (n = 90) or in vitro–produced (n = 87) embryo on Day 17. Pregnancy rates (23 d after embryo transfer) were higher for in vivo–derived embryos than for in vitro–produced embryos (58.8% vs. 31.0%, respectively; P < 0.001). Mean (+SD) plasma progesterone (P4) concentration was higher in cattle that became pregnant than that in nonpregnant cattle (5.2 + 5.0 vs. 3.8 + 2.4 ng/mL; P = 0.02). Mean pixel values (71.8 + 1.3 vs. 71.2 + 1.1) and pixel heterogeneity (14.8 + 0.3 vs. 14.5 + 0.5) were similar between pregnant and nonpregnant recipients (P > 0.10). No significant relationship was detected between pregnancy outcome and plasma P4, corpus luteum area, or corpus luteum echotexture. Embryo type, however, affected the odds of pregnancy. In conclusion, corpus luteum–related traits were poor predictors of pregnancy in recipients. The type of embryo, however, was a major factor affecting pregnancy outcome.

* Corresponding author: lgbsiqueira@yahoo.com.br

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Strategies to improve fertility in postpartum multiparous Bos indicus cows submitted to a fixed-time insemination protocol with gonadotropin-releasing hormone and prostaglandin F21


* Departamento de Produção Animal, Faculdade de Medicina Veterinária e Zootecnia-UNESP, P 18618-000, Brazil; and 1 USDA-ARS, Fort Keogh Livestock and Range Research Laboratory, Miles City, MT 59301

In Exp. 1, we evaluated the effects of 2 lengths of progesterone exposure [CIDR (controlled intravaginal drug release); 7 vs. 14 d] before a modified CO-Synch protocol [50.0-µg injection of GnRH 6.5 d before a 25.0-mg injection of PGF2] followed by another injection of GnRH and fixed-time AI (TAI) 2 d after PGF2, with or without temporary weaning (TW) before GnRH treatments, on fertility of suckled multiparous Bos indicus cows (n = 283) and on calf performance.
Timed AI pregnancy rates for cows receiving 7 d CIDR + TW, 7 d CIDR, 14 d CIDR + TW, and 14 d CIDR were 53, 47, 46, and 41%, respectively (P > 0.10). Calves submitted to two 48-h TW 6 d apart had decreased mean BW at 240 d (187.9 ± 2.7 vs. 195.5 ± 2.7 kg; P < 0.05), but BW at 420 d was not affected by TW (240.1 ± 5.1 kg). In Exp. 2, we evaluated the effect of no treatment and treatment with or without a CIDR insert between GnRH and PGF2 treatments of a modified CO-Synch protocol on pregnancy rate to TAI, and throughout a 90-d breeding season in suckled multiparous Bos indicus cows (n = 453). The inclusion of a CIDR between first GnRH and PGF2 treatments of a modified CO-Synch protocol did not improve pregnancy rate (29 and 33% for cows receiving CO-Synch + CIDR and CO-Synch protocol, respectively), and cycling cows had poorer TAI pregnancy rates than anestrous cows treated with either synchronization protocol (21.7 vs. 40.7%; P < 0.05). However, regardless of treatment with CIDR, cows submitted to TAI protocol had greater (P < 0.05) pregnancy rates at 30 (54.8 vs. 11.2%), 60 (72.1 vs. 38.8%), and 90 d (82.0 vs. 57.9%) of breeding season than untreated cows.

Data were collected from 456 dairy cows in three commercial farms. Each animal entering the dry period was assigned to one of two groups (treated and control group). All animals were then fed the same ration, which included 80 IU/kg vitamin E acetate and 0.2 ppm Se, but animals of the treated group also received an additional blend containing ammonium chloride (60 g), vitamin E [1000 IU (DL-α-tocopheryl acetate)] and Se (0.05 ppm). Calving ease was evaluated and no manual removal of placenta was attempted. Cows that retained their fetal membranes for more than 12 h after calving were considered to suffer from RFM. All animals experienced a 50-day voluntary waiting period before the first artificial insemination (AI). Treatment resulted in a decrease in the estimated average risk of RFM (10.6% vs 17.8%). Stratifying on farm the Mantel–Haenszel Relative Risk (MH-RR) estimate of RFM in treated animals relative to controlswas 1.68 (95% confidence interval, CI,1.05 to 2.68) and the Mantel–Haenszel test P-value was 0.028. Among cows that had not required assistance during delivery the average risk of RFM was greater for those without treatment (risk estimate: 10/208 or 9.7%) as compared to those with treatment (risk estimate: 20/207 or 4.8%). The MHRR estimate of RFM in treated vs. control animals was 2.95 the respective 95% CI: (0.96 to 4.17) and the MH test of association P-value was 0.058). Conversely, among cows that did require assistance during calving, the average risk of RFM estimates were 77.8% (14/18) and 91.3% (21/ 23) in treated and non-treated animals, respectively (MH-relative risk estimate of RFM=1.21, 95%CI: 0.91 to 1.60).

Using analysis of variance with farm as a random effect, treatment did not appear to have an effect on milk production of cows without RFM either at 30 or 60 days postpartum (PN0.10). Time intervals (in days) between parturition and first oestrus expression (POI), parturition and first AI

The effect of chloride ammonium, vitamin E and Se supplementation throughout the dry period on the prevention of retained fetal membranes, reproductive performance and milk yield of dairy cows
C.N. Brozos a, E. Kiossis a,*, M.P. Georgiadis b, S. Piperelis a, C. Boscos a

Faculty of Veterinary Medicine, Clinic of Productive Animal, Aristotle University of Thessaloniki, Thessaloniki, Greece
Faculty of Veterinary Medicine, Department of Animal Production, Ichthyology, Ecology and Protection of Environment, Aristotle University of Thessaloniki, Thessaloniki, Greece

We assessed the effect of an anionic salt and supplementary administration of vitamin E and Se throughout the dry period, on the risk of retained fetal membranes (RFM), milk yield and reproductive performance of dairy cows.
(PFAI) and parturition and conception (PCI) were recorded for each animal. For each time-to-event variable, survivor functions were estimated for treated and control groups using the Kaplan–Meier methodology and survival curves of treated and control groups were compared using the log-rank test, separately for the animals that did or did not experience RFM in each farm. There were significant differences in the time-to-event survival curves in only one of the three farms. Median time between parturition and first oestrus expression among animals without RFM was 67 days in treated animals and 75 in control animals, and the survival curves were statistically significantly different (P=0.021). Similarly, in the same farm, among animals that did not experience RFM the median time between parturition and conception was 114 in treated animals and 145 in controls, and the survival curves were statistically significantly different (P=0.002). In conclusion, daily administration of a blend containing ammonium chloride, vitamin E and Se throughout the dry period seems to be safe and resulted in a decrease of RFM occurrence, without any effect on milk yield.

* Corresponding author: ekiossis@vet.auth.gr

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**ARTÍCULOS DE REVISIÓN**

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ASAS Centennial Paper: Animal growth and development research: Historical perspectives

T. D. Etherton

Department of Dairy and Animal Science, The Pennsylvania State University, University Park 16802

From a historical perspective, it is difficult to identify a specific date that launched the field of endocrinology. One "biomarker" of the inception of endocrinology traces back to Ernest Henry Starling, who first introduced the word hormone in a talk given in 1905 at the Royal College of Physicians in London (Starling, 1905). A historical look at the field of endocrine regulation of animal growth since 1905 conveys that countless scientists worldwide worked to advance the scientific evidence base, which led to the commercial development of hormone-based products that enhanced growth and beneficially changed carcass composition of meat animals. This review will discuss some of seminal contributions that include the discovery of hormones (like ST and β-adrenergic agonists) that have been shown to play key roles in regulating growth and nutrient partitioning of livestock, the mechanisms by which these hormones act, and the development of products for application in animal agriculture.

2 Corresponding author: tde@psu.edu


Ca2+-stores in sperm: their identities and functions

Sarah Costello1,3, Francesco Michelangeli1, Katherine Nash1,3, Linda Lefievre1,3, Jennifer Morris1,3, Gisela Machado-Oliveira4, Christopher Barratt2, Jackson Kirkman-Brown1,3 and Stephen Publicover1,3

1School of Biosciences, University of Birmingham, Birmingham B15 2TT, UK, 2Reproductive Biology and Genetics Research Group, The Medical School, University of Birmingham, Birmingham B15 2TT, UK, 3Centre for Human Reproductive Science, Birmingham Women's Hospital, Birmingham B15 2TG, UK, 4School of Health Sciences, Piaget Institute, Algarve 6300-025, Silves, Portugal and 5Division of Maternal and Child Health Sciences, Medical School, Ninewells Hospital, University of Dundee, Dundee DD1 9SY, UK

Intracellular Ca2+ stores play a central role in the regulation of cellular [Ca2+]i and the generation of complex [Ca2+] signals such as oscillations and waves. Ca2+ signalling is of particular significance in sperm cells, where it is a central regulator in many key activities (including capacitation, hyperactivation, chemotaxis and acrosome reaction) yet...
mature sperm lack endoplasmic reticulum and several other organelles that serve as Ca²⁺ stores in somatic cells. Here, we review i) the evidence for the expression in sperm of the molecular components (pumps and channels) which are functionally significant in the activity of Ca²⁺ stores of somatic cells and ii) the evidence for the existence of functional Ca²⁺ stores in sperm. This evidence supports the existence of at least two storage organelles in mammalian sperm, one in the acrosomal region and another in the region of the sperm neck and midpiece. We then go on to discuss the probable identity of these organelles and their discrete functions: regulation by the acrosome of its own secretion and regulation by membranous organelles at the sperm neck (and possibly by the mitochondria) of flagellar activity and hyperactivation. Finally, we consider the ability of the sperm discretely to control mobilisation of these stores and the functional interaction of stored Ca²⁺ at the sperm neck/midpiece with CatSper channels in the principal piece in regulation of the activities of mammalian sperm.

Correspondence should be addressed E-mail: s.j.publicover@bham.ac.uk

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Invited review: The welfare of dairy cattle—Key concepts and the role of science
M. A. G. von Keyserlingk*,1, J. Rushen, A. M. de Passillé and D. M. Weary*
* Animal Welfare Program, University of British Columbia, 2357 Mall, Vancouver, British Columbia, Canada, V6T 1Z4
1 Agriculture and Agri-Food Canada, PO Box 1000, Agassiz, British Columbia, Canada, V0M 1A0

Concerns about the welfare of animals typically include 3 questions: is the animal functioning well (e.g., good health, productivity, etc.), is the animal feeling well (e.g., absence of pain, etc.), and is the animal able to live according to its nature (e.g., perform natural behaviors that are thought to be important to it, such as grazing)? We review examples, primarily from our own research, showing how all 3 questions can be addressed using science. For example, we review work showing 1) how common diseases such as lameness can be better identified and prevented through improvements in the ways cows are housed and managed, 2) how pain caused by dehorning of dairy calves can be reduced, and 3) how environmental conditions affect cow preferences for indoor housing versus pasture. Disagreements about animal welfare can occur when different measures are used. For example, management systems that favor production may restrict natural behavior or can even lead to higher rates of disease. The best approaches are those that address all 3 types of concerns, for example, feeding systems for calves that allow expression of key behaviors (i.e., sucking on a teat), that avoid negative affect (i.e., hunger), and that allow for improved functioning (i.e., higher rates of body weight gain, and ultimately higher milk production).

1 Corresponding author: marina.vonkeyserlingk@ubc.ca

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Is Semen Analysis Useful to Predict the Odds that the Sperm will Meet the Egg?
WV Holt
Institute of Zoology, Zoological Society of London, London, UK

Any mammalian spermatozoon that achieves successful in vivo fertilization has to perform almost perfectly in many disparate functions and overcome a series of obstacles imposed by the female reproductive tract. This implies that during formation in the testis and epididymis, the spermatozoa did not incur any morphological, metabolic, immunological or genetic abnormalities. Given that the spermatozoa are such highly differentiated cells, this means that every cellular
compartment must not only be intact but must also respond appropriately to intracellular and extracellular signals. Assuming that a spermatozoon possesses this level of perfection, and is able to reach and penetrate an oocyte, it can only be regarded as 'fertile' if the DNA it carries is intact and able to sustain embryonic development. Although the proportion of inseminated spermatozoa that meet these criteria is vanishingly small, the female reproductive tract applies stringent selection criteria during sperm transport and, as a result, the probability of conception around the time of ovulation is very high. If laboratory tests of semen quality could approach the efficacy of the female reproductive tract, it would be possible to predict the odds of spermatozoa meeting the egg; however, this is not possible at present. In this article, I suggest a simple model to illustrate how a battery of laboratory tests could eventually be used to make these predictions.

Author's address. E-mail: bill.holt@ioz.ac.uk

Role of Fatty Acids in Energy Provision During Oocyte Maturation and Early Embryo Development

RG Sturme 1, A Reis 2, HJ Leese 1,3 and TG McEvoy 2

1 Department of Biology (Area 3), University of York, York, YO10 5YW; 2 SAC, Sustainable Livestock Systems Group, West Mains Road, Edinburgh, EH9 3JG; 3 The Hull York Medical School, University of York, York, YO10 5DD, UK

While much is known about the metabolism of exogenous nutrients such as glucose, lactate, pyruvate, amino acids by oocytes and pre-implantation mammalian embryos, the role of endogenous stores, particularly lipid, has been largely overlooked. The presence of lipid within oocytes and early embryos has been long known, and comparisons between species indicate that the amounts and types of lipid present vary considerably. Large amounts of intracellular lipid can compromise the success of cryopreservation and the removal of such lipid has been the subject of considerable effort. In this review, we present evidence that strongly suggests a metabolic role for lipid, specifically with regard to energy provision, in the late-stage oocyte and the pre-implantation embryo. We focus initially on oxygen consumption as a global indicator of metabolic activity, before reviewing different approaches that either have been designed to investigate directly, or have revealed indirectly the role of endogenous lipid in energy generation. These fall under five headings: (i) fatty acid oxidation; (ii) inhibition of triglyceride oxidation; (iii) culture in the absence of exogenous substrates; (iv) cytoplasmic organization; and (v) delipidation. On the basis of the data derived from these studies, we conclude that there is strong evidence for the utilization of endogenous lipid as an energy substrate by oocytes and early embryos.

Author's address E-mail: r.g.sturme@gmail.com
Genetic parameters for oocyte number and embryo production within a bovine ovum pick-up–in vitro production embryo-production program

J.S. Merton a,*, B. Ask b, c, D.C. Onkundi c, E. Mullaart a, B. Colenbrander c, M. Nielen c

a CRV BV, P.O. Box 5073, 6802 EB Arnhem, The Netherlands
b Animal Breeding and Genetics Group, Wageningen Institute of Animal Sciences, Wageningen Agricultural University, 6700 AH Wageningen, The Netherlands
c Department of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 7, 3584 CL Utrecht, The Netherlands

Genetic factors influencing the outcome of bovine ovum pick-up–in vitro production (OPU-IVP) and its relation to female fertility were investigated. For the first time, genetic parameters were estimated for the number of cumulus-oocyte complexes (Ncoc), quality of cumulus-oocyte complexes (Qcoc), number and proportion of cleaved embryos at Day 4 (NcleavD4, PcleavD4), and number and proportion of total and transferable embryos at Day 7 of culture (NembD7, PembD7, and NTembD7, PTembD7, respectively). Data were recorded by CRV (formally Holland Genetics) from the OPU-IVP program from January 1995 to March 2006. Data were collected from 1508 Holstein female donors, both cows and pregnant virgin heifers, with a total of 18,702 OPU sessions. Data were analyzed with repeated-measure sire models with permanent environment effect using ASREML (Holstein Friesian). Estimates of heritability were 0.25 for Ncoc, 0.09 for Qcoc, 0.19 for NcleavD4, 0.21 for NembD7, 0.16 for NTembD7, 0.07 for PcleavD4, 0.12 for PembD7, and 0.10 for PTembD7. Genetic correlation between Ncoc and Qcoc was close to zero, whereas genetic correlations between Ncoc and the number of embryos were positive and moderate to high for NembD7 (0.47), NTembD7 (0.52), and NcleavD4 (0.85). Genetic correlations between Ncoc and percentages of embryos (PcleavD4, PembD7, and PTembD7) were all close to zero. Phenotypic correlations were in line with genetic correlations. Genetic and phenotypic correlations between Qcoc and all other traits were not significant except for the phenotypic correlations between Qcoc and number of embryos, which were negative and low to moderate for NembD7 (–0.20), NTembD7 (–0.24), and NcleavD4 (–0.43). Results suggest that cumulus-oocyte complex (COC) quality, based on cumulus investment, is independent from the total number of COCs collected via OPU and that in general, a higher number of COCs will lead to a higher number of embryos produced. The correlation between the estimated breeding values for Ncoc and PTembD7 of sires in this study and the sires breeding index for female-fertility based on the Dutch cattle population was close to zero. This study revealed OPU-IVP traits (NembD7, NTembD7, and Ncoc) that could be of potential value for selection. Introduction of such traits in breeding programs would enhance the number of offspring from superior donors as well as improve the cost efficiency of OPU-IVP programs.

*Corresponding author. Sybrand.Merton@crv4all.com

FGF2 is crucial for the development of bovine luteal endothelial networks in vitro

Kathryn J Woad1, Amanda J Hammond1, Morag Hunter1, George E Mann1, Morag G Hunter1 and Robert S Robinson2

1School of Biosciences and 2School of Veterinary Medicine and Science, University of Nottingham,
Sutton Bonington Campus, Loughborough, Leicestershire LE12 5RD, UK

The development of the corpus luteum requires angiogenesis, and involves the complex interplay between factors such as vascular endothelial growth factor A (VEGFA), fibroblast growth factor 2 (FGF2) and platelet-derived growth factor
(PDGF). However, the relative role of these factors remains to be elucidated. This study used a new physiologically relevant mixed luteal cell culture system to test the hypotheses that: a) FGF2 and VEGFA are critical for bovine luteal angiogenesis; and b) local luteal PDGF signalling stimulates the formation of endothelial networks. Cells were treated with receptor tyrosine kinase inhibitors against VEGFA (SU1498), FGF2 (SU5402) or PDGF (AG1295) activity. After 9 days in culture, endothelial cells were immunostained for von Willebrand factor (VWF) and quantified by image analysis. Highly organised intricate endothelial networks were formed in the presence of exogenous VEGFA and FGF2. The inhibition of FGF2 activity reduced the total area of VWF staining versus controls (O95%; P<0.001). Inhibition of VEGF and PDGF activity reduced the endothelial network formation by more than 60 and 75% respectively (P<0.05). Progesterone production increased in all treatments from day 1 to 7 (P<0.001), and was unaffected by FGF2 or PDGF receptor kinase inhibition (P>0.05), but was reduced by the VEGF receptor inhibitor on days 5 and 7 (P<0.001). In conclusion, this study confirmed that VEGF signalling regulates both bovine luteal angiogenesis and progesterone production. However, FGF2 was crucial for luteal endothelial network formation. Also, for the first time, this study showed that local luteal PDGF activity regulates bovine luteal endothelial network formation in vitro.

Correspondence should be addressed to K J Woad; Email: katie.woad@nottingham.ac.uk

**Follicle and hormone dynamics in single versus double ovulating heifers**

*S.L. Underwood *, R. Bathgate, W.M.C. Maxwell, G. Evans

Faculty of Veterinary Science, The University of Sydney, NSW 2006, Australia

The objective was to determine the in vitro characteristics of frozen-thawed dairy bull sperm after refreezing or incubation at 15 or 37 8C

The results indicated that two pre-ovulatory follicles resulted in an earlier and greater E2 increase, leading to lower FSH concentration, an earlier LH surge, and ovulation at a smaller diameter. In conclusion, the difference in hormone concentrations during the pre-ovulatory period was an effect rather than a cause of double ovulations.

Correspondence should be addressed to Eutheria Foundation, Email: ginther@vetmed.wisc.edu

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In vitro characteristics of frozen-thawed, sex-sorted bull sperm after refreezing or incubation at 15 or 37 8C

*S.L. Underwood *, R. Bathgate, W.M.C. Maxwell, G. Evans

Faculty of Veterinary Science, The University of Sydney, NSW 2006, Australia

The objective was to determine the in vitro characteristics of frozen-thawed dairy bull sperm after sex-sorting and refreezing and thawing (0, 2, and 4 h post-thaw; 37 8C) or post-sort incubation at 15 or 37 8C for 30 and 24 h, respectively. These sperm were compared with nonsorted frozen-thawed sperm (control) and with nonsorted sperm undergoing two cryopreservation procedures (FF; 0, 2, and 4 h). Frozen-thawed sex-sorted (FS) sperm maintained at 15 or 37 8C had
higher (P < 0.001) progressive motility (PM), velocity, mitochondrial function, viability, and acrosome integrity than that of control sperm but similar total motility at 0 and 2 h of incubation. Frozen-thawed sex-sorted sperm incubated at 15 8C maintained high levels of motility (66.5 + 1.6%) and viability/acrosome integrity (64.9 + 1.2%) at 24 h incubation and, after rewarming and further 6 h incubation at 37 8C, acceptable levels of motility (35.8 + 1.6%) and viability/acrosome integrity (51.2 + 1.2%) were maintained. Frozen-thawed sex-sorted sperm maintained at 37 8C had lower levels of motility, integrity, mitochondrial respiration, and velocity from 4 h of incubation onward than that of those incubated at 15 8C. However, when frozen-thawed sex-sorted sperm were refrozen (FSF), motility and velocity were depressed at all hours compared with levels exhibited by control sperm, but membrane viability/acrosome integrity and mitochondrial respiration were similar at 0 and 2 h post-thaw. Acrosome integrity of sperm in all groups undergoing sorting was exceptionally high at 0 h (>90%), even after recryopreservation and 4 h of incubation (77.5 + 1.3%). Double frozen-thawed nonsorted sperm (FF) had similar motility to FSF sperm at 0 and 2 h post-thaw but at all time points had the lowest (P < 0.001) levels of acrosome intact/visible sperm and mitochondrial respiration and the lowest velocity at 0 h. In conclusion, whereas sexsorting improved the functionality of frozen-thawed sperm, refreezing depressed motility, viability, and velocity but not acrosome integrity after extended incubation compared with that of control sperm. Furthermore, frozen-thawed, sex-sorted sperm may be stored for transport at 15 8C for up 24 h without detrimental effects on in vitro sperm characteristics.

* Corresponding author. s.underwood@usyd.edu.au


Progesterone and conceptus elongation in cattle: a direct effect on the embryo or an indirect effect via the endometrium?

M Clemente, J de La Fuente, T Fair1, A Al Naib1, A Gutierrez-Adan, J F Roche1, D Rizos and P Lonergan1

Dept de Reproduction Animal, INIA, 28040 Madrid, Spain and 1School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Dublin 4, Ireland

The steroid hormone progesterone (P4) plays a key role in the reproductive events associated with pregnancy establishment and maintenance. High concentrations of circulating P4 in the immediate post-conception period have been associated with an advancement of conceptus elongation, an associated increase in interferon-τ production and higher pregnancy rates in cattle. Using in vitro and in vivo models and ~8500 bovine oocytes across six experiments, the aim of this study was to establish the route through which P4 affects bovine embryo development in vitro and in vivo. mRNA for P4 receptor was present at all stages of embryo development raising the possibility of a direct effect of P4 on the embryo. Exposure to P4 in vitro in the absence or presence of oviduct epithelial cells did not affect the proportion of embryos developing to the blastocyst stage, blastocyst cell number or the relative abundance of selected transcripts in the blastocyst. Furthermore, exposure to P4 in vitro did not affect post-hatching elongation of the embryo following transfer to a uterine environment previously primed by elevated P4 resulted in a fourfold increase in conceptus length on Day 14. By contrast, transfer of in vitro derived blastocysts to a uterine environment previously primed by elevated P4 resulted in a fourfold increase in conceptus length on Day 14. These data provide clear evidence to support the hypothesis that P4-induced changes in the uterine environment are responsible for the advancement in conceptus elongation reported previously in cattle and that, interestingly, the embryo does not need to be present during the period of high P4 in order to exhibit advanced elongation.

Correspondence should be addressed to P Lonergan; Email: pat.lonergan@ucd.ie
Torreón, Coahuila
5, 6 y 7 de noviembre de 2009
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- Agrociencia  
  [http://www.colpos.mx/agrociencia/agrociencia.htm](http://www.colpos.mx/agrociencia/agrociencia.htm)

- Animal  
  [http://www.animal-journal.eu/](http://www.animal-journal.eu/)

- Animal Reproduction  
  [http://www.cbra.org.br/publicacoes/animalreproduction/issues.do](http://www.cbra.org.br/publicacoes/animalreproduction/issues.do)

- Animal Reproduction Science  

- Ciencia  
  [http://www.revistaciencia.amc.edu.mx/](http://www.revistaciencia.amc.edu.mx/)

- Journal of Animal Science  

- Journal of Dairy Science  
  [http://jds.fass.org](http://jds.fass.org)

- Journal of Reproduction and Development  
  [http://www.jstage.jst.go.jp/browse/jrd](http://www.jstage.jst.go.jp/browse/jrd)

- Livestock Science  

- Manejo lechero  

- Nature  
  [http://www.nature.com/nature/index.html](http://www.nature.com/nature/index.html)

- Physiological Reviews  

- Proceedings of the National Academy of Sciences of the United States of America  

- Reproduction  
  [http://www.reproduction-online.org/](http://www.reproduction-online.org/)

- Reproduction in Domestic Animals  

- Reproduction, Fertility and Development  
Noticias de Reproducción Bovina

- Science
  http://www.sciencemag.org/

- Técnica Pecuaria en México
  http://www.tecnicapecuaria.org.mx/index2.php

- The American Association of Bovine Practitioners
  http://www.aabp.org/

- The Dairy Cattle Reproduction Council (DCRC)
  http://www.dcr council.org/index.html

- The Veterinary Record
  http://veterinaryrecord.bvapublications.com/

- Theriogenology

- Veterinary Clinics of North America: Food Animal Practice
  http://www.vetfood.theclinics.com/

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