

## editorial

**"Leche sin hormonas y sin clonar al ganado"**

En los envases de leche de una de las dos marcas más importantes en México aparece el anuncio "Producimos nuestra leche de manera natural, sin antibióticos, sin hormonas y sin clonar al ganado". La mercadotecnia aguanta todo, al cabo que nadie certifica que sea verdad lo que se anuncia. Producir leche *sin antibióticos* es difícil, porque las vacas se enferman y es necesario administrarlos. Los ganaderos saben que la leche de las vacas tratadas con antibióticos debe desecharse, de lo contrario se hacen acreedores de sanciones económicas por las empresas que procesan la leche. Por otra parte, se lee también "Producimos leche sin hormonas", aunque no señala qué hormonas, debe referirse al empleo de la somatotropina bovina recombinante (bST). Esta hormona es una de las biotecnologías más importantes en la industria lechera debido a que su uso aumenta la producción entre 10 a 25%. La utilización de la bST no representa ningún riesgo para la salud ni afecta el bienestar de las vacas; aun cuando existe la percepción de que su uso "acaba" más rápido a las vacas, los estudios conducidos con rigor científico no coinciden con este punto de vista. Para el consumidor la bST no representa riesgo alguno, sin embargo, señalar que la leche proviene de vacas sin bST le crea desconfianza respecto de la leche de vacas que si reciben esta hormona. En EUA, la bST fue aprobada en 1993 por la *Food and Drug Administration* (FDA), luego de estrictas pruebas de inocuidad. Y si en Europa su uso está prohibido, no es por efectos en la salud humana sino por razones comerciales. [Capper et al \(2008; resumen incluido en este número\)](#) hicieron un análisis del impacto ambiental del uso de la bST y demostraron que la bST incrementa la eficiencia en la producción de leche y disminuye los efectos en el ambiente en comparación con otras vacas mantenidas en sistemas de producción similares, pero sin el uso de bST. Así, un millón de vacas tratadas con bST consumen menos materia seca, usan menos agua, menos tierra, excretan menos nitrógeno y fósforo, generan menos gases de efecto invernadero y consumen menos combustibles fósiles que el número de vacas sin bST necesario para producir la misma cantidad de leche. Por último, "Producimos leche.....sin clonar al ganado", esto resulta realmente maravilloso, ya que la frase indicaría que la leche de otras marcas proviene de hatos donde hay vacas clonadas. Esto es falso!!!, Y si así fuera ¿estaría afectada la calidad e inocuidad de la leche? Por supuesto que NO. Aun cuando ya se han clonado individuos de diversas especies, la clonación como técnica reproductiva está lejos de aplicarse en los hatos comerciales. De tal modo que, *amigos debemos ser críticos con la información que aparece en los productos de origen animal y no creer todo lo que anuncian.*

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V SIMPOSIO INTERNACIONAL DE GANADO LECHERO



## NOTA



“Descarga explosiva de tensiones neuromusculares”, “culminación de una sensación variable y fugaz de placer intenso que genera un estado alterado de conciencia...”, son algunas formas con las que se ha intentado describir uno de los procesos biológicos más complejos que se conocen.

**E**l orgasmo es uno de los procesos biológicos más complicados que conocemos. Durante el orgasmo se presentan la contracción de músculos de la región perineal y de otras partes del cuerpo, la elevación (casi al doble de lo normal) de la presión arterial y la frecuencia cardíaca, la contracción secuencial de los órganos del aparato genital, vocalizaciones y la secreción de diversas hormonas (como prolactina y oxitocina). Paralelamente a estos cambios somáticos y viscerales, ocurre una sensación mental de placer intenso difícil de definir con precisión. En raros casos, algunos individuos pierden el conocimiento durante el orgasmo por algunos segundos o inclusive minutos. Este evento, que fue denominado *petite mort* (pequeña muerte) o la *mort douce* (muerte dulce) ha sido explicado por cambios cardiorrespiratorios violentos como constricción de la aorta, hiperventilación (exceso de oxigenación de la sangre) o isquemia (falta de riego) cerebral.

## MANEJO REPRODUCTIVO

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## The environmental impact of recombinant bovine somatotropin (rbST) use in dairy production

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The environmental impact of using recombinant bovine somatotropin (rbST) in dairy production was examined on an individual cow, industry-scale adoption, and overall production system basis. An average 2006 U.S. milk yield of 28.9 kg per day was used, with a daily response to rbST supplementation of 4.5 kg per cow. Rations were formulated and both resource inputs (feedstuffs, fertilizers, and fuels) and waste outputs (nutrient excretion and greenhouse gas emissions) calculated. The wider environmental impact of production systems was assessed via acidification (AP), eutrophication (EP), and global warming (GWP) potentials. From a producer perspective, rbST supplementation improved individual cow production, with reductions in nutrient input and waste output per unit of milk produced. From an industry perspective, supplementing one million cows with rbST reduced feedstuff and water use, cropland area, N and P excretion, greenhouse gas emissions, and fossil fuel use compared with an equivalent milk production from unsupplemented cows. Meeting future U.S. milk requirements from cows supplemented with rbST conferred the lowest AP, EP, and GWP, with intermediate values for conventional management and the highest environmental impact resulting from organic production. Overall, rbST appears to represent a valuable management tool for use in dairy production to improve productive efficiency and to have less negative effects on the environment than conventional dairying.

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## Development of estrous synchronization protocols using melengestrol acetate in *Bos indicus* cattle

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Five experiments were conducted on commercial farms in Brazil designed to develop the basis for an estrus synchronization protocol using melengestrol acetate (MGA) in *Bos indicus* cattle. These studies resulted in the development of the following protocol: 0.5 mg·d<sup>-1</sup> of MGA between d -14 and -1; 2.0 mg i.m. injection of estradiol cypionate on d -9; 48 h temporary weaning between d 0 and 2; and natural service beginning on d 0. The basis of this protocol was to induce estrous cyclicity before postpartum loss of body condition, prevent premature luteolysis, eliminate the need for labor required to detect estrus, and consequently increase the likelihood of pregnancy early during the postpartum period. This treatment effectively induced estrous cyclicity among anestrous cows, synchronized estrus activity, and prevented premature luteolysis with no negative effect on pregnancy.

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## Effect of clinical mastitis and other diseases on reproductive performance of Holstein cows

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The objective of this study was to evaluate the effect of clinical mastitis and (or) other diseases on reproductive performance in lactating Holstein cows. Cows ( $n = 967$ ) from a commercial dairy farm were divided into four groups retrospectively: cows with clinical mastitis and other diseases (MD,  $n = 54$ ), clinical mastitis only (M,  $n = 154$ ), other diseases only (D,  $n = 187$ ), and cows with no record of clinical mastitis or other diseases (H,  $n = 572$ ). Days in milk at first service (DIMFS), services per conception (S/C), days not pregnant (DNP), the rate at which animals became pregnant over time and the proportion of cows that remained non-pregnant during 224 days of lactation were evaluated. Groups MD and M had greater ( $P < 0.05$ ) DNP compared with H ( $155 \pm 15$  and  $140 \pm 5$  vs.  $88 \pm 2$ , respectively). Moreover, MD and M had greater ( $P < 0.05$ ) S/C compared with H ( $3.0 \pm 0.4$  and  $2.1 \pm 0.1$  vs.  $1.6 \pm 0.1$ , respectively). The rate at which animals became pregnant over time was less ( $P < 0.05$ ) for MD and M and tended ( $P = 0.1$ ) to be less for D when compared with H. In addition, proportion of cows that remained non-pregnant by 224 days of lactation was greater ( $P < 0.05$ ) in MD, M, and D compared with H. Cows with mastitis were also divided into three groups according to the day of occurrence of the first case of clinical mastitis: (1) clinical mastitis occurred before 56 days postpartum (MP1); (2) clinical mastitis occurred between 56 and 105 days after parturition (MP2); and (3) clinical mastitis occurred after 105 days postpartum (MP3)

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## Effect of number of cows in estrus and confinement area on estrous behavior of beef cows<sup>1</sup>

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Mature Angus and Angus x Hereford cows were used to determine the effects of confinement area and number of cows in estrus on estrous behavior. During each of 2 replicates, 32 nonpregnant, nonlactating cows were maintained

in a drylot (60 x 100 m) or in a pasture (12 ha). Estrous cycles were synchronized with 2 injections of PGF2 $\alpha$  10 to 14 d apart at the initiation of the experiment. Thereafter, PGF2 $\alpha$  was administered between d 6 and 18 of the estrous cycle so that 1, 2 to 3, 4 to 6, or  $\geq 7$  cows were in estrus at the same time. Concentrations of progesterone were quantified in plasma at treatment to ensure cows had a normal response to PGF2 $\alpha$ . Duration of estrus and the number of mounts received during estrus were recorded by HeatWatch. If any part of estrus for a cow occurred at the same time as estrus for another cow, the cow was considered to have concurrent estrus with the other cow. Cows in the drylot had a shorter ( $P < 0.02$ ;  $61.8 \pm 3.1$  h) interval to estrus after PGF2 $\alpha$  compared with cows on pasture ( $72.8 \pm 3.3$  h). The interval to estrus was longer ( $P < 0.07$ ) when cows were treated with PGF2 $\alpha$  on d 10 to 13 ( $76.7 \pm 3.3$  h) of the estrous cycle than when treated on d 6 to 9 ( $62.3 \pm 4.7$  h) or d 14 to 18 ( $62.9 \pm 3.6$  h). Increasing the number of cows concurrently in estrus increased the number of mounts each cow received per estrus ( $P < 0.001$ ) and the duration of estrus ( $P < 0.01$ ). When only 1 cow was in estrus, she received  $11.0 \pm 6.2$  mounts during  $11.6 \pm 1.5$  h. When  $\geq 7$  cows were in estrus at the same time, each cow received  $50.4 \pm 3.2$  mounts during  $17.3 \pm 0.8$  h. Cows in drylot were in estrus longer ( $P < 0.04$ ;  $16.4 \pm 0.8$  h) than cows on pasture ( $14.2 \pm 0.7$  h). Duration of the longest interval between mounts received decreased ( $P < 0.002$ ) as the number of cows in estrus at one time increased ( $5.3 \pm 0.7$  h for 1 estrous cow;  $2.6 \pm 0.3$  h when  $\geq 7$  cows were in estrus). We conclude that increasing the number of beef cows in estrus at the same time will increase the number of times a cow is mounted and the duration of estrus. The increase in estrous behavior associated with more cows in estrus could increase the number of estrous cows detected with infrequent visual observation.

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## Effect of peripartum dietary energy supplementation of dairy cows on metabolites, liver function and reproductive variables

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Multiparous Holstein cows (n = 58) were used to study the effects of peripartum dietary supplementation on metabolic status, liver function and reproduction variables. Diets for cows were as follows: (a) no supplementation (CTL), (b) prilled fatty acids as 1.9% ofDM(PrFA), (c) calcium salts of long chain n-6 fatty acids as 2.24% ofDM(CaLFA) or (d) daily topdressing with 769 g of 65% propylene glycol (PGLY). Supplements were fed during the last 21 days before expected calving except for PGLY that continued until 21 days after parturition. Ovarian activity was monitored by transrectal ultrasonography and days to first ovulation were recorded. Liver biopsies were obtained on day 8 and 21 postpartum and analyzed for triglyceride content and mRNA expression of pyruvate carboxylase, cytosolic phosphoenolpyruvate carboxykinase, carnitine palmytoyltransferase 1A, and peroxisome proliferator-activated receptor- $\alpha$ . At 71 days following parturition, stage of ovarian cycles was synchronized and at day15 of the cycle oxytocin was injected i.v., blood samples were obtained at frequent intervals, and analyzed for 13,14 dihydro, 15-keto PGF<sub>2</sub> $\alpha$  (PGFM). Milk production and milk components were not different among treatment groups. Cows in PGLY gained body condition score (BCS) prepartum and net energy balance prepartum tended to be greater, but was not different postpartum from other groups. PGLY supplementation increased plasma insulin concentration prepartum, but not during the postpartum period. No significant differences were observed in plasma concentrations of glucose, NEFA, and insulin-like growth factor or hepatic triglyceride content, but all supplements tended to decrease  $\beta$ -

hydroxybutyrate postpartum compared to CTL cows. Abundance of mRNA of gluconeogenic and lipid oxidation genes was not different among treatment groups. Days to first ovulation and uterine PGF<sub>2</sub> production in response to an oxytocin treatment were not significantly different among treatment groups. Peripartum supplementation did not result in the substantial improvement of metabolic profile in early lactation nor significantly affect days to first ovulation and PGFM response to an oxytocin treatment.

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## Efficacy of conjugated linoleic acid for improving reproduction: A multi-study analysis in early-lactation dairy cows<sup>1</sup>

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The feeding of conjugated linoleic acid (CLA) supplements to early-lactation dairy cows has been shown to decrease milk fat synthesis and possibly improve reproductive performance. However, previously reported studies used too few animals to clearly establish the effect of CLA on reproduction. Our objective was to combine data from these studies to evaluate the association of CLA with time to first ovulation and time to conception using methods of survival analysis and overall success of pregnancy by logistic regression. A database was compiled of individual animal data (n = 212) from 5 controlled studies in which CLA had been supplemented to early-lactation dairy cows. Survival analysis incorporated both semi-parametric models (Cox proportional hazards) and parametric models (log-normal). The probability of cows becoming pregnant increased in a nonlinear manner as trans-10, cis-12 CLA dose increased, with the optimal dose predicted to be 10.1 g/d. At the optimal dose, the probability of pregnancy was

increased by 26% compared with those animals receiving no CLA (probability = 91% and 72%, respectively). Similarly, the log-normal model predicted that time to conception was decreased in a nonlinear manner with increasing trans-10, cis-12 CLA dose. The predicted optimal dose was 10.5 g of trans-10, cis-12 CLA/d and at this dose the median time to conception was decreased by 34 d when compared with those cows not receiving CLA (117 vs. 151 d in milk, respectively). The log-normal model was also the best-fit model for time to first ovulation. Overall, this multi-study analysis demonstrated a strong concordance between the nature of the dose response and the predicted optimal dose of trans-10, cis-12 CLA across the 3 reproductive variables evaluated. These results indicate that reproductive performance of dairy cows may be improved by feeding of CLA supplements during early lactation.

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pregnancies (odds ratio; OR = 3.6), resulting in an embryo survival rate of 91.9% for cows diagnosed with single compared to 75.5% for cows diagnosed with twin pregnancies. Season of breeding and milk production were associated with pregnancy loss for single pregnancies, whereas CL number was associated negatively with embryo reduction and pregnancy loss for twin pregnancies. The risk of twinning and double ovulation among pregnant cows increased with days in milk (DIM), and the risk of double ovulation was greater for cows diagnosed with ovarian cysts and lacking a CL at initiation of an Ovsynch protocol. We concluded that in this herd, embryo reduction and pregnancy loss during early gestation was greater for lactating Holstein cows diagnosed with twin compared to single pregnancies. In addition, cows diagnosed with ovarian cysts and lacking a CL had an increased risk for double ovulation.

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## Factors affecting pregnancy loss for single and twin pregnancies in a high-producing dairy herd

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Our objective was to determine the magnitude of, and factors affecting, pregnancy loss for lactating Holstein cows on a commercial dairy farm when diagnosed with twin (n = 98) or single (n = 518) pregnancies using transrectal ultrasonography. Pregnancy losses were assessed with records of non-viable embryos at first pregnancy examination and embryo losses between the first (25–40 d after AI) and second (48 and 82 d after AI) post-breeding pregnancy examinations. Among cows diagnosed with single pregnancies, 3.7% were diagnosed with a non-viable embryo at first pregnancy examination, and 4.6% of those diagnosed with a viable embryo underwent pregnancy loss by the second examination. A total of 11.2% of cows diagnosed with twins experienced a single embryo reduction, whereas 13.3% lost both embryos. Overall, the total proportion of cows experiencing pregnancy loss or experiencing embryo reduction was greater for cows diagnosed with twin than single

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## Histopathological and molecular evaluation of Holstein-Friesian cows postpartum: Toward an improved understanding of uterine innate immunity

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Bovine uterine disease reduces milk yield, impairs fertility and has implications for animal welfare. During involution, the uterus is usually exposed to multiple potential bacterial pathogens which are cleared by successful orchestration of the local inflammatory response. Unsuccessful resolution leads to the development of disease. The aim of this study was to characterize the local innate immune response in the uterus during physiological involution using histopathological and molecular analyses in 9 cows, 2 weeks after calving (early postpartum, EPP), and 4 cows, 9 weeks after calving (late postpartum, LPP). Uterine biopsies taken from each cow were

classified by histopathology, and RNA was extracted for molecular analysis. Two EPP cows were classified with a mild, 5 with a moderate and 2 with a severe inflammatory response. Relative gene expression analysis was then performed using quantitative real-time PCR (qRT-PCR) and specific primers for genes encoding Toll-like receptors (TLRs), chemokines, cytokines, acute phase proteins (APPs) and antimicrobial peptides (AMPs). TLR4, transcription factor NF $\kappa$ B1 and the inflammatory cytokines IFNG, IL1A, IL6, IL8, IL12A were all significantly increased in EPP cows ( $P < 0.05$ ). Increase in HP, SAA3, TAP and DEF5 genes was particularly marked in cows with severe inflammation. These results reveal evidence of an inflammatory uterine environment in the early postpartum period with significant induction of both AMP and APP genes. Histopathological grades in EPP cows are underpinned by quantitative changes in gene expression. Understanding the molecular mechanisms contributing to uterine immunity in the early postpartum period may identify candidate genes associated with the resolution of inflammation.

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## Luteal function and blood flow during intravenous infusion of prostaglandin F2 $\alpha$ in heifers

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The effect of prostaglandin F2 $\alpha$  (PGF) infusion for 3 h into the jugular vein on progesterone concentrations was studied in 24 Holstein heifers. Plasma concentrations of PGF were assessed by assay of 13,14-dihydro-15-keto-PGF (PGFM). The 3 h of PGF infusion were used to approximate the duration of the major concentrations of PGFM in a natural pulse. During infusion of 5, 10, or 15 mg/3 h, the concentrations of PGFM greatly exceeded the peak of a natural pulse. Plasma concentrations of progesterone decreased ( $P < 0.05$ ) in the three PGF-treated groups by Hour 1 (Hour 0 = beginning of infusion). Progesterone increased between Hours 1 and 2, but the increase was significant ( $P < 0.03$ ) only in the 5-mg group. Concentrations decreased more gradually

between Hours 2 and 6 than between Hours 0 and 1 with no differences among PGF groups. The percentage of CL area with color-Doppler signals of blood flow were elevated similarly in the three PGF-treated groups at Hours 1 to 3 and by Hour 5 decreased to below the percentage at Hour 0. In a second experiment, approximating a natural PGFM pulse by intravenous infusion of PGF at a dose of 0.7 mg/3 h did not affect plasma progesterone concentrations. Results indicated that intravenous infusion of PGF for 3 h decreased the progesterone concentration when the total dose was equivalent to doses that have been shown to be completely luteolytic when given as a single systemic injection. However, intravenous infusion of a dose of PGF that approximately simulated a natural PGFM pulse did not effect progesterone concentration.

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## Prevalence of urovagina and its effects on reproductive performance in Holstein cows

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Two hundred fifty-eight Holstein cows ( $n = 344$  lactations) from seven dairy herds were examined every month by vaginoscopy and transrectal palpation to determine the prevalence of urovagina, to investigate its effects on fertility, and to determine some risk factors for urovagina. Accumulation of urine in the vagina of a cow was diagnosed as urovagina and was classified into mild (urine only on the floor of vagina), moderate (urine covering less than or equal to half portion of the external cervical os), or severe (urine covering more than half or whole portion of the external cervical os). In total, 26.7% of lactations had urovagina (mild 11.3%, moderate 11.0%, and severe 4.4%). Survival analysis was used to derive the case definition of clinically relevant urovagina based on the factors associated with increased time to conception. Only moderate (hazard ratio [HR] = 0.39) and severe (HR =

0.20) degrees of urovagina were associated with reduction in pregnancy rate and thus defined as clinically relevant urovagina. Cows with clinically relevant urovagina had decreased AI submission rate (HR = 0.52) and pregnancy rate (HR = 0.35), required more inseminations per conception (5 vs. 2;  $P < 0.001$ ), had more days open (370 vs. 136;  $P < 0.001$ ), and were more likely not to get pregnant by 210 d postpartum (odds ratio [OR] = 6.62) and to be culled for any reasons (OR = 5.32) or for reproductive reasons (OR = 9.54) compared with those in cows with no urovagina. Cows with clinically relevant urovagina had a higher risk of endometritis (36.4% vs. 9.2%;  $P < 0.001$ ) compared with that in cows without urovagina. Cow, low BCS at first postpartum examination (OR = 2.85), endometritis within 60 d (OR = 2.50), and horizontal vulva (OR = 9.30) were risk factors for urovagina. In conclusion, 15.4% of lactations had clinically relevant urovagina that increased the risk of endometritis and had detrimental effects on fertility. Individual susceptibility, low BCS, and horizontal vulva increased the risk of diagnosing urovagina in Holstein cows.

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## Protective effects of iodixanol during bovine sperm cryopreservation

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The aim of cryopreservation is to maintain cellular integrity, thereby enabling resumption of proper biological functioning after thawing. Here we propose OptiPrep™ (60% iodixanol in water) as a protectant during sperm cryopreservation using pooled bull semen as the model. We evaluated OptiPrep concentration effect and its relation to cryopreservation by comparing frozen-thawed and chilled samples. Semen, extended in Andromed1 with 0 (control), 1.25%, 2.5%, and 5% OptiPrep™, was compared after either chilling or freezing in large volume by directional

freezing. Sample evaluation included sperm motility upon thawing and after 3 h incubation at 37 °C for frozen-thawed samples and after 3 h and 6 h of chilling for chilled samples; viability, acrosomal integrity, and hypoosmotic swelling were also tested for frozen-thawed and chilled samples. Chilled samples with 5% OptiPrep™ showed inferior viability ( $P = 0.047$ ) and 3 h motility ( $P = 0.017$ ) relative to that for chilled samples with 2.5% OptiPrep and inferior viability ( $P = 0.042$ ), acrosomal integrity ( $P = 0.045$ ), and 0 h motility ( $P = 0.024$ ) relative to that for chilled samples with 1.25% OptiPrep. The 1.25%, 2.5%, and control samples did not differ. In frozen-thawed samples, 2.5% OptiPrep was superior to all other concentrations for 3 h motility (control,  $P = 0.007$ ; 5% OptiPrep,  $P = 0.005$ ; 1.25% OptiPrep,  $P = 0.004$ ) and to 1.25% OptiPrep for acrosomal integrity ( $P = 0.001$ ). In a search for a protection mechanism, we measured glass transition temperature ( $T_g$ ) of Andromed1 and of Andromed1 with 1.25%, 2.5%, and 5% OptiPrep™. Andromed1 (−58.78 °C) and 1.25% OptiPrep™ (−58.75 °C) groups had lower mean  $T_g$  than that of the 2.5% (−57.67 °C) and the 5% (−57.10 °C) groups. Directional cryomicroscopy revealed that the presence of iodixanol alters ice crystal formation into an intricate net of dendrites. Thus, iodixanol appears to possess cryoprotective properties by helping spermatozoa maintain motility and membrane integrity, possibly through altering ice crystals formation into a more hospitable environment and increasing the glass transition temperature.

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## Reproductive performance of dairy cows is influenced by prepartum feed restriction and dietary fatty acid source

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The objective of this study was to determine the effects of feed restriction and source of dietary

fatty acids during the close-up dry period on postcalving reproductive performance of dairy cattle. Thirty-four days before expected calving, pregnant Holstein cows (n = 72; parity 1 to 5) were randomly assigned to 1 of 6 treatments. Treatments were ad libitum (AL) or 24% feed restriction (FR) in combination with 1 of 3 oilseed supplements at 8% of diet dry matter: canola, linola, or flax to enrich the rations with oleic, linoleic, or linolenic fatty acids, respectively. After calving, cows were fed a common lactation diet that contained no oilseeds. Measurements of uterus, corpus luteum, and follicles were obtained by ultrasonography twice weekly from  $7 \pm 1$  d after calving until the first ovulation. Cows (n = 66) were subjected to timed artificial insemination (TAI), and pregnancy was determined 32 d later. Feed-restricted cows had lower dry matter intake and lost more body weight prepartum. Energy balance (Mcal/d) was negative in FR cows prepartum but they had a less severe negative energy balance postpartum. The dietary source of fatty acid did not affect energy balance. Cows fed AL had a higher incidence of uterine infections (10/37 vs. 2/35) but tended to have fewer ovarian cysts (2/37 vs. 7/35) than FR cows. Mean ( $\pm$ SE) interval from calving to uterine involution did not differ among dietary treatments ( $26.8 \pm 1.8$  d). Interval from calving to first ovulation was longer in cows fed canola than in those fed either linola or flax ( $34.7 \pm 3.1$  vs.  $23.7 \pm 3.2$  and  $21.0 \pm 3.1$  d, respectively). A greater percentage of cows fed AL conceived to the first TAI (47.1 vs. 18.8) and tended to have fewer mean days open ( $157 \pm 10.8$  vs.  $191 \pm 10.1$ ) than cows fed FR. In summary, FR cows had a lower incidence of uterine infections, but they were less fertile as reflected by a lower percent pregnancy to first TAI and increased days open. Cows fed diets enriched in linoleic or linolenic fatty acids had a lesser incidence of ovarian cysts and ovulated sooner with no effect on energy balance or fertility.

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J. Anim Sci. 2009. 87 (6) 2160-2167

## The environmental impact of dairy production: 1944 compared with 2007<sup>1</sup>

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A common perception is that pasturebased, low-input dairy systems characteristic of the 1940s were more conducive to environmental stewardship than modern milk production systems. The objective of this study was to compare the environmental impact of modern (2007) US dairy production with historical production practices as exemplified by the US dairy system in 1944. A deterministic model based on the metabolism and nutrient requirements of the dairy herd was used to estimate resource inputs and waste outputs per billion kg of milk. Both the modern and historical production systems were modeled using characteristic management practices, herd population dynamics, and production data from US dairy farms. Modern dairy practices require considerably fewer resources than dairying in 1944 with 21% of animals, 23% of feedstuffs, 35% of the water, and only 10% of the land required to produce the same 1 billion kg of milk. Waste outputs were similarly reduced, with modern dairy systems producing 24% of the manure, 43% of CH<sub>4</sub>, and 56% of N<sub>2</sub>O per billion kg of milk compared with equivalent milk from historical dairying. The carbon footprint per billion kilograms of milk produced in 2007 was 37% of equivalent milk production in 1944. To fulfill the increasing requirements of the US population for dairy products, it is essential to adopt management practices and technologies that improve productive efficiency, allowing milk production to be increased while reducing resource use and mitigating environmental impact.

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J. Dairy Sci. 2009. 92:2562-2571

## The value of reproductive tract scoring as a predictor of fertility and production outcomes in beef heifers<sup>1</sup>

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In this study, 272 beef heifers were studied from just before their first breeding season (October 15, 2003), through their second breeding season, and until just after they had weaned their first calves in March, 2005. This study was performed concurrently with another study testing the economic effects of an estrous synchronization protocol using PG. Reproductive tract scoring (RTS) by rectal palpation was performed on the group of heifers 1 d before the onset of their first breeding season. The effect of RTS on several fertility and production outcomes was tested, and the association of RTS with the outcomes was

compared with that of other input variables such as BW, age, BCS, and Kleiber ratio using multiple or univariable linear, logistic, or Cox regression. Area under the curve for receiver operating characteristic analysis was used to compare the ability of different input variables to predict pregnancy outcome. After adjustment for BW and age, RTS was positively associated with pregnancy rate to the 50-d AI season ( $P < 0.01$ ), calf weaning weight ( $r = 0.22$ ,  $P < 0.01$ ), and pregnancy rate to the subsequent breeding season ( $P < 0.01$ ), and negatively associated with days to calving ( $r = 0.28$ ,  $P < 0.01$ ). Reproductive tract scoring was a better predictor of fertility than was Kleiber ratio and similar in its prediction of calf weaning weight. It was concluded from this study that RTS is a predictor of heifer fertility, compares well with other traits used as a predictor of production outcomes, and is likely to be a good predictor of lifetime production of the cow.

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## ARTÍCULOS DE REVISIÓN

Reproduction (2009) 137 889–899 .

### Cell cycle regulatory control for uterine stromal cell decidualization in implantation.

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Uterine stromal cell decidualization is integral to successful embryo implantation, which is a gateway to pregnancy establishment. This process is characterized by stromal cell proliferation and differentiation into decidual cells with polyploidy. The molecular mechanisms that are involved in these events remain poorly understood. The current concept is that locally induced factors with the onset of implantation influence uterine stromal cell proliferation and/or differentiation through modulation of core cell cycle regulators. This review will aim to address the currently available knowledge on interaction between growth factor/homeobox and cell cycle regulatory

signaling in the progression of various aspects of decidualization.

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Theriogenology 71 (2009) 1333-1342

### Postpartum anestrus in dairy cattle

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Fertility of the postpartum period is negatively influenced by the incidence of anestrus. The latter condition is characterized by the absence of estrous behavior, which may be an indication of suboptimal conditions (e.g., inadequate peripartum nutrition) or pathologic conditions (e.g., chronic debilitating diseases or uterine and

ovarian diseases). Although initiation of ovarian follicular growth in the postpartum period is generally not affected, subsequent development (deviation) and the fate of the dominant follicle are the primary factors that affect reestablishment of ovarian cyclicity. Anestrus can be classified based on the three functional states of follicular development; that is, follicle emergence, deviation, and ovulation. Prevention of anestrus is preferable to treatment and can be achieved in part by maintaining a healthy periparturient period. To better understand the etiology of anestrus and its prevention, research is urgently needed in the following three areas: the role of peripartum disease conditions that influence reproduction, genes involved in ovulation, and the influence of proteins (e.g., leptin) that appear to be important links between metabolic signals and the neuroendocrine axis.

Theriogenology. Jun;71(2009) 1343-1357

## **Compilation of classical and contemporary terminology used to describe morphological aspects of ovarian dynamics in cattle.**

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Veterinarians and scientists involved in applied and basic research in cattle require a lexicon of

terms that is used uniformly so that diagnoses and inference of results between and among studies can be correctly interpreted and substantiated or negated and therapy and hypotheses can be formulated without unnecessary confusion and redundancy in treatments and experiments. This review provides a compilation of many of the classical and contemporary terms used in association with ovarian dynamics primarily during the estrous cycle in cattle, which can also apply to other reproductive states. While many classical terms used to describe healthy and diseased conditions associated with follicles and corpora lutea are still applicable today, there are some that have become antiquated (e.g., cystic corpus luteum, cystic ovarian degeneration, luteolysis, and granulosa cell tumor), due, in part, to advanced technology (e.g., ultrasonography) and a more thorough understanding of ovarian function. In this regard, older terms have been revised (e.g., corpus luteum with a cavity, follicular and luteinized-follicular cysts, structural and functional luteal regression, and granulosa-theca cell tumor) and newer terms have been coined (e.g., follicle deviation) and advocated herein. Defining and adopting terminology used in bovine reproduction that is clear, precise and understandable and available in a single source, is expected to make the exchange of clinical and research information and outcomes more effective, safe, and economical.

## **FISIOLOGÍA REPRODUCTIVA**

J. Anim Sci. 2009. 87:1971-1980

## **Evaluation of antral follicle count and ovarian morphology in crossbred beef cows: Investigation of influence of stage of the estrous cycle, age, and birth weight<sup>1,2</sup>**

**R. A. Cushman<sup>\*,3</sup>, M. F. Allan<sup>\*</sup>, L. A. Kuehn<sup>\*</sup>, W. M. Snelling<sup>\*</sup>, A. S. Cupp<sup>†</sup> and H. C. Freetly<sup>\*</sup>**

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Depletion of the ovarian reserve is associated with reproductive senescence in mammalian females, and there is a positive relationship between the size of the ovarian reserve and the number of antral follicles on the surface of the ovary. Therefore, we conducted a series of experiments to investigate the influence of stage of the estrous cycle, age, and birth weight on antral follicle counts (AFC) in beef cows and heifers. Pairs of ovaries were collected from crossbred beef cows at slaughter (n = 72) or at necropsy (n = 333; 0 to 11 yr of age); all visible antral follicles were counted, the ovaries were weighed, and stage of the estrous cycle was estimated based on ovarian

morphology. There was no influence of estimated stage of the estrous cycle on AFC ( $P = 0.36$ ). There was a small but positive effect of birth weight on AFC [AFC =  $-1.7 + 0.31(\text{birth weight})$ ;  $P = 0.007$ ,  $r^2 = 0.05$ ]. When antral follicle counts were regressed on age, there was a quadratic effect of age such that AFC increased until 5 yr of age and decreased thereafter [AFC =  $12.9 + 9.0(\text{yr}) - 0.86(\text{yr}^2)$ ;  $P < 0.001$ ,  $r^2 = 0.22$ ]. In a third experiment, crossbred beef heifers ( $n = 406$ ; 353 to 463 d of age) at 3 locations were subjected to ovarian ultrasonography on unknown day of the estrous cycle. Heifers were classified as low AFC (<15 follicle,  $n = 84$ ) or high AFC (>24 follicles,  $n = 178$ ). Whereas estimated stage of the estrous cycle did not influence AFC ( $P = 0.62$ ), heifers classified as low AFC had smaller ovaries ( $P = 0.001$ ), decreased birth weight ( $P = 0.003$ ), and a decreased heifer pregnancy rate ( $P = 0.05$ ) compared with heifers in the high AFC group. From these results, we conclude that AFC in beef cows and heifers is influenced by birth weight and age but not by stage of the estrous cycle. In beef cows, the number of antral follicles increases to 5 yr of age and then begins to decline. This may indicate that a decrease in fertility due to decline of the ovarian reserve may begin earlier than previously thought in beef cows.

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Anim. Reprod., v.6, n.2, p.409-415, Apr./Jun. 2009

## Expression of fibroblast growth factor 13 (*Fgf13*) mRNA in bovine antral follicles and corpora lutea

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<sup>2</sup>Departamento de Fisiologia, Instituto de Biociências, Universidade Estadual Paulista, Botucatu, São Paulo, Brazil.

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<sup>4</sup>Centre de Recherche en Reproduction Animale, Faculté de Médecine Vétérinaire, Université de Montréal St-Hyacinthe, Quebec, Canada.

Recent studies have suggested a paracrine role for several fibroblast growth factors (FGFs) in the regulation of follicle and luteal development. *Fgf13* is a non-secreted FGF that has been

previously localized to the developing gonads, but it is not known if it is expressed in the adult ovary. The objective of the present study was to determine the expression pattern of *Fgf13* mRNA in the bovine ovary. *Fgf13* mRNA expression was examined by semiquantitative RT-PCR using *Gapdh* as the internal control gene in theca and granulosa cells, corpora lutea (CL) and oocytes collected from abattoir ovaries. Follicles were grouped according to estradiol content (<5, 5-20, >20-100 and >100 ng/ml) and size (5-7, 8-10 and >10 mm diameter). CL samples were morphologically classified into four developmental stages. *Fgf13* mRNA expression was assessed in pools containing 50 oocytes aspirated from follicles larger than 4 mm in diameter. ANOVA was used to test for the main effects of follicle size group, and estradiol concentration group in granulosa and theca cells, and to test the effect of CL developmental stage on *Fgf13* mRNA abundance. *Fgf13* mRNA was detected in the CL and in somatic follicle cells, but not in oocytes. Thecal *Fgf13* expression increased with increasing follicle diameter but did not change with intrafollicular estradiol concentrations. No evidence of developmental regulation of *Fgf13* mRNA expression was observed in granulosa cells and CL. The present data demonstrate for the first time the expression of an intracellular FGF in the bovine ovary and suggests that *Fgf13* mRNA is upregulated in bovine theca cells during antral follicle growth.

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Anim. Reprod., v.6, n.2, p.371-379, Apr./Jun. 2009

## Angiogenic factors and ovarian follicle development

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Faculty of Veterinary Medicine, Laboratory of Manipulation of Oocytes and Preantral Follicles (LAMOFOPA), State University of Ceara, Fortaleza, CE, Brazil.

Ovarian follicles require an adequate blood supply for oxygen, nutrients and hormones, in addition to eliminating CO<sub>2</sub> and other metabolites. Acquisition of an adequate vascular supply is probably a limiting step in the selection and maturation of the dominant follicle. In this way, there is a progressive interest in the study of the growth factors involved in the angiogenic process. In

addition, a better understanding about the mechanisms that regulate the expression and action of these factors could be a key point to increase the reproductive performance in females. Therefore, this review aims to summarize current

data on the importance of the pro- and anti-angiogenic growth factors which regulate angiogenesis in ovarian follicle development.

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## PRÓXIMOS EVENTOS

### V SIMPOSIUM INTERNACIONAL DE GANADO LECHERO

Fecha: 20 - 22 mayo de 2009.

Sede: Hotel Crowne Plaza, Torreón Coahuila, México

Informes: [decvet@servidor.unam.mx](mailto:decvet@servidor.unam.mx)

[www.fmvz.unam.mx](http://www.fmvz.unam.mx)

**SITIOS DE INTERÉS**

Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación

<http://www.sagarpa.gob.mx>

Confederación Nacional de Organizaciones Ganaderas

<http://www.cnoq.com.mx>

Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias

<http://www.inifap.gob.mx>

Facultad de Medicina Veterinaria y Zootecnia

<http://www.fmvz.unam.mx>

Academia Veterinaria Mexicana, A.C.

<http://www.academiaveterinaria.org>

Asociación Mexicana de Médicos Veterinarios Especialistas en Bovinos, A.C.

<http://www.AMMVEB.net>

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[www.fedmvz.com](http://www.fedmvz.com)

Organización de las Naciones Unidas para la Agricultura y la Alimentación

[www.fao.org](http://www.fao.org)

Organización Panamericana de la Salud.

[www.cinu.org.mx/onu/estructura/mexico/org/ops.htm](http://www.cinu.org.mx/onu/estructura/mexico/org/ops.htm)

Revista Veterinaria México

<http://www.fmvz.unam.mx/fmvz/revvetmex/revvetmex.htm>

Dirección General de Salud Animal

[http://senasicaw.senasica.sagarpa.gob.mx/portal/html/salud\\_animal/introduccion/introduccion.html](http://senasicaw.senasica.sagarpa.gob.mx/portal/html/salud_animal/introduccion/introduccion.html)

American Dairy Science Association (ADSA)

<http://www.adsa.org/>

Dairy and Animal Science (The Pennsylvania State University)

<http://www.das.psu.edu/>

College of Agriculture. Animal & Food Sciences (University Of Kentucky)

<http://www.uky.edu/Ag/AnimalSciences/index.html>

Electronic Zoo (NetVet Veterinary Resources –Cows Sites)

<http://netvet.wustl.edu/cows.htm#dairy>

Dairy Cattle Nutrition UW-Extension (University of Wisconsin)

<http://www.uwex.edu/ces/dairynutrition/>

Fundación Española para el Desarrollo de la Nutrición Animal

<http://www.etsia.upm.es/fedna/introtablaf.htm>

JOHNE´S Information Center (University of Wisconsin)

<http://www.johnes.org/>



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## V SIMPOSIO INTERNACIONAL DE GANADO LECHERO

UNAM / Intervet Schering-Plough Salud Animal

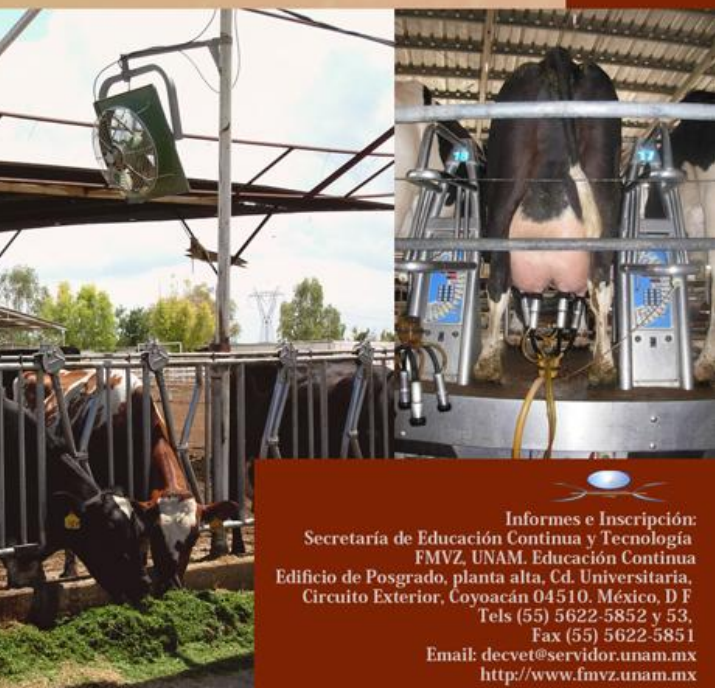
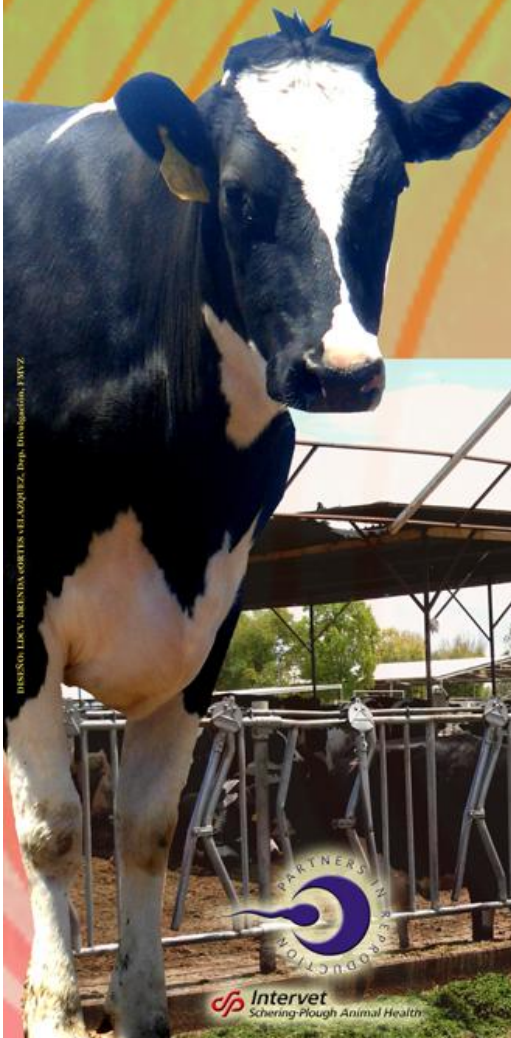
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- Diagnóstico y tratamiento de problemas digestivos durante el periodo de transición.
  - El balance energético posparto y su influencia en la reproducción.
- Manejo clínico de los problemas metabólicos durante el posparto.
  - Manejo de la vaca para aumentar la eficiencia reproductiva.
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