32 Effects of NutriDense^{TM} and waxy corn hybrids on site and extent of starch and protein disappearance and efficiency of microbial N production in sheep.

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Corn grains harvested from the corn hybrids, Exsegen 617 (conventional yellow dent corn), Exsegen 404ND (NutriDense^{TM} corn, high oil and protein), and Exsegen ESX4WX (waxy corn, high amylopectin) from ExSeed Genetics L.L.C. (Decatur, IL) were used in a study to investigate their effects on site and extent of starch and protein disappearance, and efficiency of microbial N production. Six wether lambs surgically fitted with ruminal, duodenal, and ileal cannulas were fed three diets in a 3 x 6 Latin rectangle design with 21 d periods. Diets were: 1) conventional yellow dent corn (CC), 2) NutriDense^{TM} corn (NC), and 3) waxy corn (WC). Diets contained approximately 44.0% cracked corn grain, 39.0% cottonseed hulls, 15.0% soybean meal, and 2.0% mineral and vitamin mix (DM basis). Chromic oxide (0.21% of DM) was used as a marker. Lambs were fed twice daily in the amount of 1.8 x NE_m requirement. Data were analyzed using GLM procedure of SAS. True starch disappearance in the rumen was higher for WC than CC (86.9, 91.4 and 98.5% for CC, NC and WC, respectively). Apparent starch disappearance in the small intestine was higher for NC and WC than CC (88.3, 93.8 and 95.9% of duodenal starch flow for CC, NC and WC, respectively). Apparent daily starch disappearance in the hindgut was higher for CC than WC (7.61, 1.79 and 0.24 g/d for CC, NC and WC, respectively). Apparent total tract starch disappearance was highest for WC and lowest for NC (99.8, 99.7 and 99.9% for CC, NC and WC, respectively). Daily flow of total N, bacterial N, NH_3-N, and non-NH_3 nonbacterial N at the duodenum were similar among diets. Bacterial N production efficiencies, (gram of bacterial N per kg of true or apparent OM disappearing in the rumen) were similar among diets. Apparent N disappearance from the small intestine was also similar among diets. However, apparent N disappearance from the hindgut was -0.81, -1.06 and -1.46 g.d for CC, NC and WC, respectively, and demonstrated a statistically significant effect between CC and WC diets. Total tract apparent N disappearance was similar among diets. Results suggested that starch in waxy corn grain is more digestible in the rumen than conventional yellow dent corn. This higher starch digestion, however, did not increase bacterial N production compared to conventional yellow dent corn.

Key Words: NutriDense^{TM}, Waxy, Disappearance

33 Synthetic conjugated linoleic acid may cause mammary involution in dairy cows.

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In view of the potential of synthetic CLA as a means to increase the CLA content of bovine milk, this study was undertaken to evaluate the effect of synthetic CLA on milk component synthesis. Four Holstein cows received abomasal infusion of: (1) control, no fat infusion (CTL), (2) 150g/day of synthetic CLA, 31.7% c-9, t-11; 30.4% t-10, c-12 (CLA), (3) 150g/day of safflower oil (SAFF), and (4) 150g/day of tallow (TALL). Infusion was carried out for 20-22 hours/day for 11day periods in a 4x4 Latin square design. Data from the last two days of each period was used for statistical analysis. The milk fat concentration of c-9, t-11 CLA was 0.59, 0.58, 0.61, and 1.77% of fatty acid methyl esters for CTL, SAFF, TALL and CLA respectively. The concentration of t-10, c-12 CLA was 0.85% for CLA, but not detected with the other treatments. Milk yield dropped by 35 to 40% with CLA infusion. Percentage and yield of lactose and fat were also significantly lower with CLA. The surprisingly lower concentration of lactose with CLA infusion was counterbalanced by a higher concentration of sodium. Percentage of protein was significantly higher with CLA infusion although the yield of protein was lower compared to the other treatments. Somatic cell count was approximately five to seven times greater as a result of CLA infusion compared to the other treatments. This was unexpected since there were no visible signs of mastitis during milking. Subsequent analysis of the milk revealed no evidence of bacterial infection. During the early stages of drying-off similar changes are seen in the mammary secretion as were observed with infusion of CLA. Although purely speculative, it is possible that infusion of unnaturally large amounts of these synthetic CLA isomers was initiating the involution process in the mammary gland.

Item	CTL	TALL	SAFF	CLA
Milk yield, kg/day	24.2^a	23.0^a	26.6^a	15.0^b
Lactose, %	3.86^a	3.86^a	4.04^a	3.36^b
Fat, %	2.36^a	2.46^a	2.39^a	1.66^b
Protein, %	3.04^a	2.98^a	3.14^a	4.35^b
Somatic cell count, X1000/ml	187^a	193^a	133^a	991^b
Sodium, mg/kg	715^a	748^a	658^a	978^b
Chloride, %	0.192^a	0.192^a	0.188^a	0.252^b

Within a row, values with different superscripts are significantly different ($P < 0.05$).

Key Words: Conjugated linoleic acid, involution

34 The biohydrogenation of oleic acid to *trans* monoenes by ruminal microbes in vitro.

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According to most reports, oleic acid is directly hydrogenated to stearic acid by ruminal microbes without the formation of *trans* intermediates. However, feeding fat supplements high in oleic acid content to lactating cows has often increased the concentration of *trans* monoenes in ruminal contents and milk. The purpose of this study was to determine if *trans* monoenes are formed from oleic acid biohydrogenation or if oleic acid is directly hydrogenated to stearic acid as depicted in reviews. Oleic-1-^{13}C acid and oleic acid were each added to four in vitro cultures of mixed ruminal microbes taken from a ruminally cannulated Holstein cow. Samples were taken at 0, 24, and 48 hours and methylated. Fatty acid methyl esters (FAME) were separated into fatty acid fractions differing in degree of saturation using a silver impregnated solid phase extraction column. The unsaturated FAME fractions were converted to dimethyl disulfide derivatives and analyzed by gas chromatography mass spectroscopy. After 48 hours, the concentrations of oleic acid decreased 1.9 mg/5 ml of culture, stearic acid increased 1.3 mg/5 ml of culture, and *trans* monoenes increased 0.3 mg/5 ml of culture. Total *trans* monoenes at 48 hours averaged 0.4 mg/5 ml of culture and consisted of *trans*-9 (49%), *trans*-10 (16%), *trans*-11 (25%), and *trans*-12 (9%) octadecenoic acids. Enrichments were calculated from the mass abundance of ^{13}C in major fatty acid fragments and expressed as a percentage of total carbon isotopomers. Enrichment of ^{13}C at 0 hours was found in stearic acid (10.9%), oleic acid (85.2%), and *trans*-9 (85.4%) octadecenoic acid. At 24 hours, enrichment of ^{13}C was found in stearic acid (37.5%), oleic acid (84.8%), *trans*-9 (85.0%), *trans*-10 (77.4%), *trans*-11 (39.9%), and *trans*-12 (72.7%) octadecenoic acids. At 48 hours, enrichment of ^{13}C was found in stearic acid (35.8%), oleic acid (85.3%), *trans*-9 (84.2%), *trans*-10 (77.1%), *trans*-11 (47.4%), and *trans*-12 (73.3%) octadecenoic acids. It can be concluded that the biohydrogenation oleic acid by mixed ruminal microbes involves the formation of several positional isomers of trans monoenes rather than only stearic acid as previously described.

Key Words: Oleic acid, Biohydrogenation, *Trans* monoenes

35 Effects of long chain unsaturated fatty acids on palmitic acid metabolism by ruminant hepatocytes.

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The objective was to determine the effects of long chain unsaturated fatty acids on the metabolism of palmitic acid to oxidation or cellular lipid products. Hepatocytes were isolated from four ruminating calves and exposed in suspension for 3 hours to one of the following treatments: 1 mM palmitic acid (1C16), 2 mM palmitic acid (2C16), or 1 mM of palmitic acid plus 1 mM of oleic (C18:1), linoleic (C18:2), linolenic (C18:3), eicosapentaenoic (C20:5), or docosahexaenoic (C22:6) acid. Oxidation of [1-^{14}C]palmitic acid to CO_2 and acid-soluble products (ASP), or incorporation into cellular triglyceride (TG), phospholipid (PL), cholesterol (C), and cholesterol ester (CE) were measured. Overall, addition of C20:5 yielded the highest rates of palmitic acid oxidation followed by addition of C18:1 and C22:6. Addition of C18:2 or C18:3 resulted in the lowest rates of palmitic acid metabolism to most metabolic products, whereas addition of C18:1 and 2C16 yielded the highest rates of palmitic acid incorporation into TG and total cellular lipids. Addition of C20:5 and C22:6 yielded the highest rates of palmitic acid incorporation into C and, similar to C18:2 and C18:3, decreased TG formation from palmitic acid compared with the addition of C16 or

C18:1. These results show that long chain unsaturated fatty acids can have a direct affect on palmitic acid metabolism by bovine hepatocytes. Values in the table below represent incorporation of [1-^{14}C]palmitic acid into metabolic products ($p$mol/ug DNA/3 h).

Prod.	1C16	2C16	C18:1	C18:2	C18:3	C20:5	C22:6	SEM
CO_2	74.9^{bc}	66.4^{cd}	87.3^{ab}	56.8^{d}	73.8^{bc}	96.2^{a}	94.2^{a}	14.7
ASP	253.8^{bc}	203.7^{cd}	314.4^{b}	174.1^{d}	262.3^{bc}	417.0^{a}	289.2^{b}	50.0
Total Oxidation[1]	328.6^{cd}	270.0^{de}	401.7^{b}	230.9^{e}	336.3^{c}	513.2^{a}	388.4^{bc}	62.7
TG	192.7^{b}	299.4^{a}	289.5^{a}	146.2^{c}	178.6^{bc}	219.6^{b}	19 5.0^{b}	48.5
PL	102.8^{bc}	126.5^{a}	108.8^{b}	81.0^{d}	89.8^{cd}	108.3^{b}	102 $.9^{bc}$	15.1
C	29.3^{bc}	34.7^{b}	34.6^{b}	28.9^{bc}	24.9^{c}	42.1^{a}	47.5^{a}	8.1
CE	36.2^{b}	47.6^{a}	41.0^{ab}	39.2^{ab}	38.8^{b}	37.5^{b}	37.6^{b}	10.4
Total Cellular Lipid[2]	362.2^{bc}	507.2^{a}	474.1^{a}	295.0^{d}	330.9^{cd}	379. 7^{bc}	392.2^{b}	70.5

^{abcde}Means within a row with unlike superscripts differ ($P<0.05$). [1]Total Oxidation = CO_2 + ASP. [2]Total Cellular Lipid = TG + PL + C + CE.

Key Words: fatty acids, hepatic metabolism, bovine

36 Programmed exercise altered carbohydrate and lipid metabolism of dairy cows.

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Objective was to determine the effects of a programmed exercise regimen (PER) and pregnancy of dairy cows on blood glucose (GLU), lactate (LACT), non-esterified fatty acid (NEFA), β-hydroxybutyrate (BHB) concentrations and glucose tolerance. Holstein non-lactating, multiparous pregnant or non-pregnant cows (n=52) were blocked by parity and expected calving date and assigned randomly to treatments: no exercise or exercise at a walk (3.25 km/h) every other day for 1.25 h, d 0 to 30; and, 1.5 h, d 31 to calving (d 70 of PER) in a mechanical walker with a circular lane (33.8 m circumf.). All cows completed treadmill exercise tests (ET) on d 0, 30 and 60 of PER. Treadmill ET consisted of walking 4 km/h for 3 min followed by 5 km/h with incremental increases in incline every 3 min until cows refused to walk. Jugular blood was sampled every 3 min during ET and 18 min recovery period (RP) after ET. Venous plasma concentrations of GLU and LACT were higher for non-exercised compared with exercised cows and increased as time increased during ET ($P<0.05$). Plasma LACT concentrations were slightly higher for exercised pregnant cows compared with exercised non-pregnant cows ($P<0.05$). Concentrations of NEFA during ET were higher for pregnant cows compared with non-pregnant cows and higher for non-exercised compared with exercised cows ($P<0.07$). Concentrations of BHB declined faster for exercised cows compared with non-exercised cows as time during ET increased ($P<0.05$). During RP, plasma concentrations of GLU, LACT, and NEFA decreased as time increased ($P<0.01$). Exercised cows had lower plasma LACT than non-exercised cows during RP for d 60 ET compared with d 0 and d 30 ET ($P<0.05$). Concentrations of BHB during RP were higher for exercised compared with non-exercised cows as time increased ($P=0.05$). During the RP following d 60 ET, concentrations of NEFA were highest for pregnant cows as compared with non-pregnant cows ($P<0.01$). The PER did not affect glucose tolerance. During glucose tolerance tests, pregnant cows had lower basal concentrations of GLU and insulin compared with non-pregnant cows. When given a GLU bolus (150 mg/kg BW), plasma insulin increased less for pregnant compared with non-pregnant cows ($P<0.05$). The PER altered GLUC, LACT, BHB and NEFA metabolism during ET, but did not alter glucose tolerance.

Key Words: Exercise, Pregnancy, Dairy cows

37 Bovine lymphocytes express prolactin receptor (PRL-R) mRNA: a potential mechanism for PRL effects on immune function.

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Photoperiod is known to influence prolactin (PRL) secretion in cattle and has been implicated in enhancement of the immune system in rodents. Such enhancement is potentially through the actions of PRL, which is known to have cytokine-like activity. Lymphocytes of humans and rodents are known to express PRL-R mRNA, however no studies have been performed to show the existence of PRL-R mRNA in lymphocytes of cattle. In addition, whether photoperiod has an effect on expression of PRL-R in cattle has not been studied. The objective of this study was to determine the existence of PRL-R mRNA in lymphocytes and to gain initial insight into the possibility that photoperiod influences the immune function in cattle. Blood was collected from Holstein calves via jugular venipuncture and lymphocytes were separated by centrifugation on Ficoll hypaque density gradients. Total RNA was isolated from lymphocytes using TRIzol reagent, and converted to cDNA. Real-time polymerase chain reaction (PCR) was performed using an ABI PRISM® 7700 Sequence Detector, with 18S as the endogenous control. Bovine lymphocytes expressed PRL-R mRNA suggesting that PRL may have direct action on these immune cells. Thus it is likely that PRL, as mediated by photoperiod, may have an impact on immune function in cattle via its receptors in lymphocytes. Further studies are underway to begin to elucidate the effects of photoperiod on PRL-R expression in lymphocytes.

Key Words: Cattle, Prolactin receptor, Lymphocytes

38 Trends in milk production and composition in dairy herds in Saskatchewan: August, 1997 to July, 2000.

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The objective was to study trends of milk production and milk composition in dairy herds in Saskatchewan, Canada over three years. The first two years of the study, the province was on a volume based pricing system and quota system. Both multiple component pricing (MCP) and a quota system based on kilograms of butterfat were implemented on the first day of the final year of the study. From August 1, 1997 to July 31, 2000 farm numbers decreased from 402 farms to 381 farms. However, total milk production for the province increased linearly each year. In the 1997-1998 dairy year milk fat percentage, milk protein percentage and other solids percentage were 3.63, 3.25 and 5.51 % respectively. In 1998-1999 the milk composition was 3.64% for milk fat, 3.26 % for milk protein and 5.52 % for other solids. During the final year of the study, milk fat, milk protein and other solids percent were 3.66, 3.23 and 5.51 % respectively. Results show that during the 1999-2000 dairy year, milk fat percentage was higher ($P<0.05$) than in 1997- 1998 and 1998- 1999. Milk protein percentage was significantly lower ($P<0.05$) in 1999-2000 than in the previous two years of the study. Seasonal variation for milk production and milk fat percentage was similar for all years. Milk protein and milk fat percentages were highest in the October, November and December (fall) and lowest in the June, July and August (summer). Milk protein percentage was similar for 1997-1998 and 1998-1999 dairy years with the exception of November 1998, which was significantly higher than in other years. In the 1999- 2000 dairy year, milk protein percent was lower than other years from November to March. Changes in milk production and composition may have reflected a change in policy of milk pricing and quota allocation. Because of the economic advantage to producers, it would be expected that milk production would go up. However, it was unexpected for milk fat percentage to go up and milk protein percentage to go down.

Key Words: milk composition, multiple component pricing, trends

39 The effects of dietary protein fractions and levels on performance and nitrogen utilization and excretion in early lactation dairy cows.

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Treatment diets varying in crude protein (CP) and rumen undegradable protein (RUP) and calculated to supply a duodenal Lys:Met ratio of about 2.9:1 were corn silage based and fed as a TMR to sixty-five Holsteins from 21 to 120 days in milk to determine effects on performance and nitrogen utilization. Diets contained %CP and calculated %RUP (of CP) as follows: 1) 19.4%, 40% (CON), 2) 16.5%, 34% (LPLU), 3) 16.8%, 40% (LPMU), 4) 16.8%, 46% (LPHU), 5) 17.2%, 43% (LPHU+UREA), which is the result of adding 1% urea to LPHU. Diets contained approximately 24% ADF, 1.5 Mcal/kg NE_L, and 6.5% fat. Milk urea nitrogen (MUN) values were used to calculate predicted amounts of urinary nitrogen (UN) using the relationship: UN (g/d) = 12.54 X MUN (mg/dl). CON cows had greater CP and RUP intake, plasma urea nitrogen, rumen ammonia, MUN and predicted UN. Milk yield, fat yield, fat percent, protein yield and protein percent were not significantly different

(P>0.05). Cows on CON gained more weight than cows on other treatments (P<0.025). Parity by treatment was not significant(P>0.05). In this study, cows fed LPHU had lower MUN and predicted UN without limiting production.

Item	CON	LPLU	LPMU	LPHU	LPHU + UREA	Treatment P<	Parity P<
DMI (kg/d)	23.32	22.88	23.12	23.39	24.08	.823	.001
CP intake (kg/d)	4.53^{a}	3.78^{b}	3.89^{b}	3.92^{b}	4.13^{b}	.001	.001
RUP intake (kg/d)	1.81^{a}	1.29^{b}	1.55^{c}	1.80^{a}	1.78^{a}	.001	.001
ADF intake (kg/d)	5.46	5.57	5.99	5.36	5.72	.107	.001
NE_L intake (Mcal/d)	36.07	34.96	34.79	36.18	37.10	.576	.001
Milk yield (kg/d)	35.28	32.98	33.50	33.34	35.25	.748	.001
Milk CP%	3.11	3.01	3.02	3.04	3.06	.583	.341
Milk fat%	3.35	3.36	3.42	3.17	3.05	.137	.356
MUN (mg/dl)	21.92^{a}	15.99^{b}	17.57^{c}	14.32^{d}	$17.03^{b,c}$	.001	.44 4
Predicted UN (g/d)	274.5^{a}	200.2^{b}	220.0^{c}	179.2^{d}	$213.3^{b,c}$	.001	.448
PUN (mg/dl)	15.62^{a}	$11.71^{b,c}$	12.37^{b}	10.68^{c}	12.59^{b}	.001	.13 0
NEFA (Meq/l)	.168	.197	.210	.188	.206	.193	.001
Rumen NH_3 (mg/dl)	12.10^{a}	$8.39^{b,c}$	9.27^{b}	7.38^{c}	9.21^{b}	.001	.155
A:P ratio	2.33	2.50	2.53	2.46	2.32	.193	.330

∗LS Means Reported

Key Words: Rumen undegradable protein, Nitrogen excretion, Dairy cattle

40 The effect of increasing alfalfa haylage particle size on physically effective NDF values.

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Physically effective NDF (peNDF) is defined as that dietary fiber source which effectively stimulates rumination and salivation. The peNDF value of feed has been determined by measuring the amount of NDF retained on a 1.18 mm screen. Changing cut length of forage results in changes in the proportion of large particles (>19.0 mm). The Penn State Particle Separator (PSPS) was modified to measure both small (<1.18 mm) and large particles. The objective of this experiment was to evaluate effective fiber requirements of cows in early lactation based on measurements of the PSPS. Eight cannulated, multiparous cows averaging 19 DIM and 642 kg BW were assigned to one of two 4X4 Latin Squares. During each of the 23 d periods animals were offered one of four diets, which were chemically identical but included alfalfa haylage of different particle size; short (SH), mostly short (MSH), mostly long (MLG), and long (LG). Total peNDF was similar across diets (27.2, 27.7, 27.9, 28.1) but the amount of particles >19.0 mm increased with increasing particle size (3.0, 12.4, 21.9, 31.3%). Increasing haylage particle size decreased DMI linearly (23.3, 22.0, 20.9, 20.8 kg for SH, MSH, MLG, LG respectively; P<0.05). Milk production and percent fat did not differ across treatments (P>0.10; 35.5 kg milk, 3.32% fat). Ruminal pH increased quadratically (6.04, 6.15, 6.13, 6.09; P<0.05) but A:P ratio increased linearly (2.75, 2.86, 2.88, 2.92; P<0.0001) with increasing particle size. Total time ruminating increased quadratically (467, 498, 486, 468 min/d; P<0.05) but time eating increased linearly (262, 253, 298, 287 min/d; P<0.05) with increasing particle size. Both eating and ruminating efficiency increased with increasing particle size (11.2, 11.5, 14.1, 14.1 min/ kg DM; 20.5, 23.2, 23.4, 23.9 min/kg DM; P<0.05). Based on rumen pH and total time ruminating, these results suggest higher effective fiber values should be assigned to rations with 12-22% of the particles >19.0 mm and that peNDF values should be adjusted based on the proportion of larger particles in the diet.

Key Words: NDF, pH, Rumination

41 Rumen inert lipids and glucose precursors lessen prepartum feed intake depression and improve carbohydrate status in periparturient dairy cows.

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In a trial to determine the effects of dietary fat and glucose precursors on ketosis and postpartum health of dairy cows, 24 multiparous Holstein cows were divided into two groups. The treatment group (**T**) received 0.45 kg/d Metaxerol^{TM}, a specific combination of rumen inert lipid, calcium propionate, propylene glycol, and niacin (Pestell, Inc., Ontario Canada), and the control group (**C**) received 0.45 kg/d of a 50:50 mixture of calcium salts of fatty acids and ground barley. Treatments were added to the diet from 14 d before until 21 d after calving. Liver samples were collected by puncture biopsy at -14 and -2 d prepartum and at 2, 7, 14 and 28 d postpartum. Blood samples were taken via tail venupuncture immediately prior to each liver biopsy and at -7 d prepartum and 21 d postpartum. Production of milk and milk fat, protein, and lactose were not different. A numerical, but not significant, decrease was observed in milk fat percentage from T cows during the first week of lactation (5.5 vs. 6.4% for T and C, respectively, $P = 0.20$). The DMI for T cows was greater than for C cows during the last week prior to calving (15.4 vs. 13.4 kg/d $P = 0.05$). There was no decrease in DMI for T cows during the prepartum period; whereas DMI of C cows during the last week prepartum decreased by 3.2 kg/d compared with the previous week. Although liver lipid concentrations were numerically decreased in T cows on d 7, differences were not significant (8.1 vs. 9.6% wet wt, $P = 0.17$) and glycogen concentrations of livers did not differ also. The T cows had greater blood glucose concentrations, pre-calving (70.75 vs. 62.1 mg/dl) and post-calving (60.06 vs. 56.24 mg/dl, $P = 0.04$). Accordingly, total number of days of ketosis was less for T cows than for C cows (11 vs. 29 d). Feeding Metaxerol^{TM} for 2 wk before parturition until 3 wk postpartum helped avoid periparturient feed intake depression, increased carbohydrate status as evidenced by increases in blood glucose, and may be beneficial in prevention of ketosis.

Key Words: Periparturient, Ketosis, Fatty Liver

42 Differences in resistance to heat shock between 2-4 cell Brahman and Holstein embryos produced in vivo.

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Exposure of in vitro produced embryos to elevated culture temperature (heat shock) reduces development. Heat shock effects were greater for Holstein (H) embryos than for Brahman (B) at d 4 after fertilization. Objectives were to test if embryos produced in vivo are susceptible to heat shock, if breed differences in this response exist at the 2-4 cell stage, and to determine breed effects on estrous synchronization and superovulation. Holstein (n=24) and B (n=29) cows with a corpus luteum were injected with 100 μg GnRH (d 0) and 12.5 mg $PGF_{2\alpha}$ (d 7 and d 8). The proportion of cows displaying standing estrus was higher (P=0.08) for H (50 vs 29%) - there was no significant difference for estrus based on tail paint (71 vs 58%). Forty cows detected in estrus were superovulated using FSH. Luteolysis was induced with $PGF_{2\alpha}$ and cows were inseminated 36 and 48 h later using semen from the same breed as the donor. At first insemination, 100 μg GnRH was given. Ten cows of each breed were killed 48 h after GnRH and oviducts flushed. Embryos were cultured for 24 h. Then, 2-4 cell embryos were cultured at either 38.5^{o}C or 41^{o}C for 4.5 h. Thereafter, all embryos were cultured at 38.5^{o}C. There were no breed effects on ovulation rate (16.6 vs 15.2 for H and B, respectively) or embryo recovery rate (69 vs 66%). Cleavage rate (CR) at slaughter was lower (P≤0.001) for H than B (16±3.5 vs 43±3.8%) but CR at the time 2-4 cell embryos were separated was higher (P≤0.001) for H than B (74±3.8 vs 63±4.1%). Heat shock reduced development but there were no significant breed by temperature interactions. For example, the proportion of embryos that developed to blastocyst was 16.2±5.0% vs 0.0±4.1% for H at 38.5^{o}C and 41^{o}C, respectively, and 13.05.2% vs 0.0±5.3% for B (temperature, P≤0.05). In conclusion, 2-4 cell embryos produced in vivo can be disrupted by heat shock. There was no evidence that H embryos were more sensitive to heat shock than B embryos at this stage in development.

Key Words: Breeds, Heat shock, Embryo