0.5 mg/ml of oligosaccharides (PMO), of which 50% is sialyllactose. Some strains for rotavirus (RV) require sialic acid for binding to enterocytes, thus we hypothesized that PMO would inhibit RV infectivity. To test this hypothesis, oligosaccharides were purified from defatted human milk (HMO), pig colostrum collected during parturition, and pig milk collected 3-10 days post-parturition by gel filtration. Samples were further subjected to protein A affinity chromatography to remove immunoglobulins. HMO and PMO were analyzed by HPAE chromatography on Dionex PA100 columns and found to yield distinctive oligosaccharide profiles. Purified HMO and PMO were assessed for their ability to inhibit infection of cultured MA-104 cells by human sialic acid independent RV (Wa strain) or porcine sialic acid dependent RV (OSU strain) using a focus forming unit assay. PMO and HMO were studied in a dose-dependent manner and data were expressed as the oligosaccharide dose required to inhibit RV infectivity by 50% compared to control. Approximately 1.32 mg/ml of purified HMO inhibited OSU strain RV infection by 50% ($P<0.05$), but did not inhibit infection by Wa strain RV. Similarly, 1.5 mg/ml of purified PMO from colostrum inhibited ($P<0.05$) infection by the OSU strain RV by 50%. In contrast, 2.5 mg/ml of purified PMO from mature milk was required to achieve a 50% inhibition ($P<0.05$) of OSU strain RV infectivity. No consistent inhibition of Wa strain RV by PMO was observed. In summary, a higher dose of mature milk PMO was required for an equivalent degree of RV inhibition obtained with HMO or colostral PMO. These data imply that changes in the PMO composition from colostrum to mature milk may confer differential protection from RV. Additional fractionation of PMO is ongoing and should yield isolated structures for further comparison.

Key Words: Milk, Oligosaccharides, Rotavirus

604 Glucose and histidine affect the phosphorylation state of translation initiation factor 2 in the bovine mammary gland in vivo. C. A. Toerien*, D. R. Trout, and J. P. Cant, *University of Guelph*, *Guelph, ON, Canada*.

In eukaryotic cells, nutrients activate the cell signalling cascades that regulate protein synthesis at the level of translation. Eukaryotic translation initiation factor (eIF) 2 is a major control point in translation initiation. Phosphorylation of the α subunit inactivates eIF2 and impairs ribosome loading onto mRNA. To identify nutrients that regulate eIF2 in the mammary gland, Holstein cows were fasted to decrease protein synthesis before re-supplying nutrients. In a 6x6 Latin Square design, cows (initial: 69±4 DIM; 43.4±0.5 kg milk/d) were subjected every 14 d to a 31-h fast. For the last 9 h of the fast, cows were infused iv with EAA+Glc (positive control), Glc, Met+Lys, His, Leu, or saline (Sal; negative control). Milk production response to infusion was calculated from milk produced in the front quarters between +1 and +7 h of the 9-h infusion. At +9 h, an approximately 1.5-g biopsy sample of mammary tissue was harvested from a hindquarter (HQ). In successive periods, HQs were alternated so that each HQ was allowed 28 d to recover. Relative to Sal, infusion of EAA+Glc and Glc increased ($P<0.05$) total protein yield by 40% and 36% respectively. The effect of His on protein yield equalled 52% of the effect of EAA+Glc, which is far greater than its 5% proportion in the EAA of the EAA+Glc infusate. The stimulatory effect of EAA+Glc, Glc and His on protein yield was accompanied by a dephosphorylation of eIF2α. Although infused in a smaller proportion of EAA+Glc, His elicited a similar level of eIF2α dephosphorylation to that of Glc. In conclusion, glucose and His, but not Met+Lys or Leu, regulate the phosphorylation state of eIF2α in the bovine mammary gland.

Phosphorylation of eIF2a

	Treatment (LSmeans±SE)					
Item	Sal	EAA+Glc	Glc	Met+Lys	His	Leu
Milk protein, g/6h	59^{a}±2.8	82^{b}±3.3	80^{bc}±3.2	67^{abc}±3.2	71^{abc}±3.2	61^{ac}±3
eIF2a(P), %*	99±11	73±10	49±12	95±12	51±11	84±12
eIF2a, %*	101±14	105±14	110±16	111±16	99.4±14	128±16
eIF2a(P), %†	22.6^{a}±2.4	11.5^{b}±2.4	8.6^{b}±2.7	13.4^{ab}±2.7	8.5^{b}±2.4	13.2^{ab}±2.7
Inclusion, %y			100	19.8	5	17.3

[a,b,c] Significance ($P<0.05$); * of Sal when Sal was set to 100; † of total eIF2a; y of EAA+Glc infusate

Key Words: Milk Protein Regulation, Translation Initiation Factors, Nutrients

Physiology and Endocrinology: Effects of Maternal Nutrient Supply on Embryonic and Fetal Development and Postnatal Performance

605 Effects of maternal metabolic state and intra-uterine crowding on embryonic survival and fetal development in swine. G. Foxcroft*, J. Barry, W. Dixon, S. Novak, M. Vinsky, E. Putman, S. Town, G. Murdoch, A. Wellen, S. Terletski, and J. Patterson, *University of Alberta*, *Edmonton, AB, Canada*.

Maternal metabolic state has important effects on embryonic survival in the pig. A switch towards a less positive energy balance in the cyclic gilt, and increased tissue catabolism in the lactating and weaned sow, produce detrimental effects on embryonic survival. Endocrine and metabolic profiling during follicular development and use of in vitro maturation and fertilization techniques, suggest that both the follicle and the enclosed oocyte can be nutritionally imprinted. Inherent deficiencies in oocyte maturation are a primary cause of poor embryonic survival, increasing variability in fertilization rate and early embryonic development. Embryonic development is further confounded by adverse effects of metabolic state on steroid-dependent changes in secretory function of both the oviduct and uterus. Dynamic changes in the pattern of prenatal loss may also affect fetal development through naturally occurring intra-uterine crowding. Studies of commercial dam-line sows, suggest that selection for litter size has indirectly increased ovulation rates in higher parity females (>30 ovulations), and increased the number of conceptuses surviving to the post-implantation period. Increased uterine crowding around day 30 of gestation decreases placental size in all surviving conceptuses. In prolific Meishan sows, increased uterine crowding also reduces placental weight, but this is partly compensated by increased placental vascularity. In contrast, in white-line sows, such compensatory changers in placental efficiency are not evident and uterine crowding results in intra-uterine growth retardation (IUGR) and a decrease in the number of secondary muscle fibers in the fetus. Available evidence suggests that these effects on prenatal development will have significant negative effects on postnatal growth.

Key Words: Swine, Preantral Survival, Uterine Crowding

606 Pre-gestational ewe management systems alter the impacts of early maternal undernutrition on fetal growth and offspring quality. S. Ford*[1], M. Du[1], B. Hess[1], and P. Nathanielsz[2], [1]*University of Wyoming*, *Laramie*, [2]*University of Texas*, *San Antonio*.

This study investigated if the management system a ewe was selected under alters the impacts of maternal undernutrition on fetal growth and offspring quality. Range ewes normally experiencing limited nutrition from Baggs, WY (Baggs ewes) maintained normal fetal weights when subjected to nutrient restriction (50% NRC requirements; NR) from day 28 to 78 of gestation. In contrast, ewes of similar breeding from the University of Wyoming flock (UW ewes), selected to a sedentary lifestyle and above adequate nutrition, exhibited a 30% decrease in fetal weight, under the same NR. The growth restricted fetuses of UW ewes exhibited bilateral cardiac ventricular hypertrophy, reduced kidney nephron numbers, and fewer secondary myofibers and smaller fasciculi in skeletal muscle than fetuses from control fed (100% NRC requirements; CF) UW ewes. The ability of NR Baggs ewes to maintain normal fetal weights was linked to an early placentomal conversion from Type A to more efficient Types B, C, or D by

day 78 of gestation. When NR UW and Baggs ewes were re-alimented from day 79 to term, size, viability and birth weights were similar for lambs born to NR and CF ewes. At 2 months of age, lambs born to NR UW ewes exhibited increased levels of glucose and insulin, before and after an i.v. infusion of 250 mg/kg glucose. By 8 months of age, these same lambs exhibited elevated glucose and a reduced insulin release to the i.v. glucose infusion. Further, lambs from NR UW ewes ate more, grew faster, were fatter and had markedly higher blood pressures at 9 months of age than lambs from CF UW ewes. To date, we have observed no differences in postpartum growth rate, insulin sensitivity or pancreatic function between lambs from NR and CF Baggs ewes. The abnormalities exhibited by the lambs born to NR UW ewes are consistent with a predisposition to health problems later in life such as obesity, type II diabetes, hypertension, and cardiovascular disease.

Key Words: Maternal Undernutrition, Sheep, Offspring Quality

607 Timing of nutrient restriction and programming of fetal adipose tissue development. M. Symonds*, H. Budge, M. Gnanalingham, T. Stephenson, and D. Gardner, *Centre for Reproduction and Early Life, Institute of Clinical Research, University Hospital*, *Nottingham, UK*.

Timing of maternal nutrient restriction has pronounced effects on fat deposition and endocrine sensitivity in the growing fetus that primarily occur in the absence of any change in total fetal weight. Nutrient restriction targeted over the period of maximal placental growth in sheep, has no initial effect on fetal fat mass. However, at term after restoration of the maternal diet to the same level as controls, previously nutrient restricted offspring possess more fat with increased abundance of mRNA for insulin-like growth factors, the mitochondrial protein uncoupling protein 2, and peroxisome proliferator activated receptor γ. The sensitivity of this fat to glucocorticoids is also enhanced, as there is a parallel increase in mRNA abundance for the glucocorticoid receptor in conjunction with an increased capacity to synthesise cortisol and a reduced ability to inactivate it via 11-β-hydroxysteroid dehydrogenase types 1 and 2, respectively. These adaptations in cortisol sensitivity persist into later life and are paralleled by the large increase in fat growth that occurs after birth. Critically, fat deposition in offspring of nutrient restricted mothers is enhanced when they are maintained in an environment in which physical activity is significantly reduced. In contrast, maternal nutrient restriction in late gestation coincident with the period of maximal fetal growth results in reduced fat mass at term. These offspring, however, possess more fat at one year of age in conjunction with increased insulin receptor β subunit abundance and reduced glucose transporter-4 abundance. The maternal and therefore fetal nutritional environment has substantial effects on both immediate and later fat deposition that are mediated in part by changes in endocrine and metabolic sensitivity of adipose tissue. These adaptations can place the offspring at increased risk of excess fat deposition in later life, particularly when exposed to a sedentary lifestyle.

Key Words: Nutrient Restriction, Fetal Growth

608 Nutrient partitioning in the growing adolescent sheep: consequences for conceptus development. J. M. Wallace*, *Rowett Research Institute*, *Aberdeen, UK*.

When pregnancy coincides with the continued growth of the mother, the normal hierarchy of nutrient partitioning may be altered at the expense of the conceptus. Thus in human adolescents, the risks of spontaneous miscarriage, prematurity, low birth weight and neonatal death are particularly acute in young girls who are still growing at the time of conception. To investigate the underlying mechanisms and the consequences for the fetus we have nutritionally manipulated maternal growth in young pregnant sheep. Thus when singleton bearing adolescent sheep are overnourished to promote rapid maternal growth throughout pregnancy, growth of both the placenta and fetus is impaired relative to control-fed adolescents of equivalent age. Rapid maternal growth is also associated with increased spontaneous abortion rates in late gestation and, for ewes delivering live young, is characterised by a reduction in gestation length and in the quality and quantity of colostrum produced at parturition. Nutritionally- sensitive hormones of the maternal somatotrophic axis may orchestrate this alteration in nutrient partitioning. In rapidly growing adolescent dams, insulin and IGF-1 concentrations are high and promote a sustained anabolic drive to maternal tissue deposition (primarily of adipose tissue). In contrast, maternal GH concentrations are low and GH supplementation of overnourished dams alters maternal metabolism and enhances nutrient supply to the fetus in late pregnancy. By late pregnancy, placental mass in the rapidly growing versus the control dams is reduced by approximately 45%. These growth- restricted pregnancies are associated with major reductions in absolute uteroplacental blood flows and attenuated fetal nutrient uptakes. The resulting fetuses display asymmetric growth restriction and are hypoxic, hypoglycemic and hypoinsulinaemic. Counter-intuitively, indices of fetal adiposity are enhanced, while the ontogeny of prenatal reproductive development is perturbed in both sexes. These observations have implications for postnatal body composition and fertility respectively.

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Key Words: Pregnancy, Nutrition, Fetus

Ruminant Nutrition: Beef—Feedlot

609 Effect of cooked molasses block supplementation and flax on newly received calf performance. D. Larson*[1], M. Bauer[1], G. Lardy[1], and J. Stewart[2], [1]*North Dakota State University*, *Fargo*, [2]*Tublicks, LLC*, *Wyndmere, ND*.

One-hundred forty-four crossbred steers were used to evaluate the effect of supplemental cooked molasses blocks with and without flax on newly received calf health and subsequent performance. We hypothesized that calves would consume blocks, thereby, increase nutrient intake during periods of low feed intake which typically occur after weaning. Steers were assigned randomly to one of three treatments: control (C, no block), block without flax (WOF), and block including ground flax (WFA). Steers were assigned to pen (8 pens/treatment) as they exited the truck. Two-day weights were collected initially and every 2 weeks thereafter for 6 weeks. Calves were fed a diet consisting of dry rolled corn (48%), alfalfa/grass hay (30%), shredded beet pulp (20%), and a supplement (2%) formulated to contain a minimum of 12.5% CP, 0.60% Ca, and 0.30% P (DM basis). Steers were vaccinated for clostridial and viral diseases prior to arrival, given a viral booster, and given parasiticide upon arrival. Calves were allowed free access to their respective treatment blocks at all times. Block intake was determined by weighing the tub refusal upon replacement with a new tub. Data were analyzed using the MIXED procedure of SAS with treatment as the fixed effect. There were no differences ($P \geq 0.50$) attributed to treatment for the weights taken at arrival, days 14-15, 26-27, or at the conclusion of the trial. Nor was ADG (1.45±0.12 kg/day) different between treatments ($P = 0.70$). Daily DMI of the ration (7.93±0.43 kg/day) was not different among treatments ($P = 0.60$) and averaged 2.66% of body weight. Block intake (0.16±0.03 kg/day) was not different between WOF and WFA ($P = 0.32$). Gain to feed (0.18 ±0.01) was not different between treatments ($P = 0.56$). The number of calves treated per pen was not different among treatments ($P = .12$). For the calves used in this study, providing supplemental nutrients in the form of a cooked molasses block, with or without flax, did not improve animal performance or health.

Key Words: Flax, Beef Steers, Health