regulatory capacity of animal health. Several species working groups (bison, cattle and equine) initially recommended the implementation of low frequency (LF) radio-frequency identification (RFID) technology based on internationally recognized ISO 11784/11785 standards in order to achieve the goal of a 48-hour trace back when the system is fully operational. LF technology has been manufactured, on an industrial basis, since the mid 1990s and is used in multiple animal identification systems worldwide. The subsequent adoption of a technology-neutral position by USDA to ensure a level playing field for all types of technologies has created a surge of startup companies promising new technologies that are readily available off the shelf and capable of offering improved solutions to existing LF technology at a fraction of the cost. Emerging technologies have not been validated under a variety of livestock environments for transponder retention and read range performance. Moreover, performance standards do not exist for any existing technology at the present time. The USDA has recognized the importance of standardization within NAIS for ensuring compatibility across vendors and international recognition of identification technologies used within the system. The USDA has subsequently endorsed the use of ISO 11784/11785 standards for livestock producers who elect to use RFID in the NAIS with the proviso for establishment of voluntary consensus standards for emerging technologies in the US through the American National Standards Institute (ANSI). This institute could facilitate the acceptance of standards for emerging technologies at the international level. All technologies must be fairly and consistently evaluated in transparent testing environments. The development of this process is essential for ensuring that NAIS– approved technologies can achieve the primary objective while providing the most economical means of individual identification for the livestock producer.

Key Words: Animal Identification, Technology

Ruminant Nutrition: Intake Behavior/Acidosis/Metabolism - Dairy

898 Feed sorting in dairy cattle: Effects of repeated acidosis challenges. T. J. DeVries*[1], F. Dohme[2], and K. A. Beauchemin[1], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB*, [2]*Agroscope Liebefeld-Posieux*, *Posieux, Switzerland*.

An experiment was conducted to determine if dietary forage content influences feed sorting by dairy cattle and whether this changes during acidosis. Eight ruminally cannulated cows were assigned to either a high (HF, 60% forage) or low forage (LF, 45% forage) diet (DM basis). Following a 2 wk adaptation, cows were exposed to 2 repeated acidosis challenges (2 periods) separated by 14 d. The challenge consisted of restricting feed to 50% of ad libitum intake for 24 h, followed by a meal of 4 kg of ground barley/wheat before ad libitum allocation of TMR (challenge day). Ruminal pH was measured continuously. Feed and orts were sampled for 2 baseline days, on the challenge day, and 1, 2 and 5 d after the challenge day for each animal and subjected to particle size analysis. The separator contained three screens (18, 9, and 1.18 mm) and a bottom pan to determine the proportion of long, medium, short and fine particles, respectively. Sorting activity was calculated as actual intake as a percentage of predicted intake. To determine if sorting occurred, each fraction was tested for a difference from 100%. The bout of acidosis following the challenge was more severe ($P<0.05$) in period 2 and was greatest ($P<0.05$) for cows fed LF. Cows fed LF sorted ($P<0.01$) for medium particles (107%), but against long (92%), short (98%), and fine particles (90%). Cows fed HF sorted ($P<0.01$) for medium (103%) and short particles (102%), but against long particles (89%). Overall, sorting for medium particles and against fine particles were greater ($P<0.01$) on the LF diet. Diet × period × day interactions ($P<0.01$) indicated that during period 2, LF cows decreased their sorting against long particles and increased sorting against short and fine particles on the day after the challenge when acidosis was most severe. These results suggest that the proportion of forage in the diet affects how dairy cows sort their feed. Furthermore, cows experiencing severe acidosis preferentially sort their feed to attenuate the effects of this disease.

Key Words: Acidosis, Sorting, Forage

899 Severity of ruminal acidosis increases with repeated bouts particularly when cows are fed low forage diets. F. Dohme*[1], T. J. DeVries[2], K. A. Beauchemin[2], K. M. Krause[3], and K. S. Schwartzkopf-Genswein[2], [1]*Agroscope Liebefeld-Posieux, Research Station ALP*, *Posieux, Switzerland*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB*, [3]*West Virginia University*, *Morgantown*.

An experiment was conducted to determine the response of cows to repeated acidosis challenges. Eight lactating ruminally cannulated cows were assigned to one of 2 diets (DM basis): high fiber (HF, 60% forage) or low fiber (LF, 45% forage). Following a 2-wk adaptation, cows were exposed to 3 acidosis challenges (3 periods), each separated by 14 d. The challenge consisted of restricting feed to 50% of *ad libitum* intake for 24 h, followed by a meal of 4 kg of ground barley/wheat before *ad libitum* allocation of TMR (challenge day). Ruminal pH was measured continuously. Total acidosis was defined as pH < 5.8, moderate acidosis as pH < 5.5, and severe acidosis as pH < 5.2. The entire grain allotment was consumed by all cows in Period 1, 6 cows in Period 2, and only 3 cows in Period 3. Despite reduced grain intake in each period, the severity of acidosis increased ($P < 0.05$) in each period: mean pH dropped by 0.13 pH units, minimum pH dropped by 0.20 units, and duration of total acidosis increased by 2 h/d. Furthermore, the severity of acidosis following the challenge was greater for cows fed LF compared to HF, as evidenced by diet × period interactions ($P < 0.05$) for area under the total acidosis threshold, area under the moderate acidosis threshold, and duration of acute acidosis. Those variables indicated that the severity of acidosis increased from Period 1 to 3 by 3 to 6-fold for cows fed LF and by 2 to 4-fold for cows fed HF. This study indicates that cows become more prone to acidosis over time even though they alter feed intake to avoid acidosis. The severity of each subsequent bout of acidosis increases, especially when cows are fed diets low in physically effective fiber. Therefore, a bout of acidosis that occurs due to improper feed delivery or poor diet formulation can have long-term consequences on cow health and productivity.

Key Words: Acidosis, Ruminal pH, Physically Effective Fiber

900 Grain-induced subacute ruminal acidosis (SARA) stimulates translocation of lipopolysaccharide (LPS) into the blood, and increases acute phase proteins in bovine plasma and milk. E. Khafipoor*, D. O. Krause, and J. C. Plaizier, *University of Manitoba*, *Winnipeg, MB, Canada*.

The effects of grain-induced subacute ruminal acidosis (SARA) on translocation of lipopolysaccharide (LPS) into the blood, and acute phase proteins in plasma and milk were determined in lactating Holstein cows. Between wk 1 and 5 of two successive 6 wk periods, cows received total mixed ration (TMR) ad-libitum with a forage-to-concentrate (F:C) ratio of 50:50. In wk 6 of both periods, SARA was induced by replacing, on average, 21% of DM of the TMR with pellets containing 50% wheat and 50% barley, resulting in a F:C ratio of 29:71. Rumen pH was monitored continuously using in-dwelling pH probes. Rumen fluid and peripheral blood samples were collected 15 min before feeding and 6 and 12 h after feeding for two days during wk 5 (control) and 6 (SARA). Induction of SARA significantly reduced average daily pH from 6.17 to 5.97 and increased the duration of rumen pH below pH 5.6 to above 180 min/d, which was taken as the threshold for SARA. SARA also reduced dry matter intake (16.5 vs. 19 kg/d), milk yield (28 vs. 31.2 kg/d), and milk fat (2.82 vs. 3.41%, 0.79 vs. 0.99 kg/d), but increased milk protein percentage (3.58 vs. 3.28 %) without affecting milk protein yield (0.94 vs. 0.98 kg/d). Concentrations of free-LPS in rumen fluid and blood plasma were also increased by SARA. In response to plasma LPS, blood concentrations of the acute phase proteins serum amyloid-A (SAA), haptoglobin (Hp), and LPS-binding protein (LBP) were increased during SARA. The data suggest that grain-induced SARA increases lysis of Gram-negative bacteria and translocation of LPS into the peripheral blood, and that this triggers an immune response.

Table 1. Rumen LPS, plasma LPS and acute phase proteins during SARA

Item	Control	SARA	P-value
Rumen LPS, EU/ml	28,400	107,700	0.005
Plasma LPS, EU/ml	<0.05	0.52	0.004
LBP in plasma, µg/ml	18.0	53.0	0.018
LBP in milk, µg/ml	3.00	6.94	0.02
Hp in plasma, µg/ml	0.0	484.0	0.001
SAA in plasma, µg/ml	77.6	218.6	0.01

Key Words: Subacute Ruminal Acidosis, Plasma LPS, Acute Phase Response

901 Induction of subacute ruminal acidosis (SARA) by replacing alfalfa hay with alfalfa pellets does not stimulate inflammatory response in lactating dairy cows. E. Khafipoor*, D. O. Krause, and J. C. Plaizier, *University of Manitoba*, *Winnipeg, MB, Canada*.

To determine if SARA induced by feeding diets with a short particle length results in similar increases in free bacterial lipopolysaccharide endotoxin (LPS) in rumen fluid and peripheral blood than grain-induced SARA, four rumen fistulated and four non-rumen fistulated dairy cows were used in a 6 wk study. During wk 1, cows received a diet containing 50% DM as concentrate and 50% DM chopped alfalfa hay. Between wk 2 and wk 6, alfalfa hay was gradually replaced with alfalfa pellets. Rumen fluid and peripheral blood were sampled before and 8 h after feeding. Rumen pH was monitored continuously in the rumen fistulated cows. Replacing alfalfa hay with alfalfa pellets reduced average daily pH (6.35 vs. 5.78), milk yield (35.9 vs. 32.7 kg/d) and milk fat (3.22 vs. 2.32%) and increased milk protein (3.04 to 3.80 %) and rumen VFA (90 to 122 mM). SARA was induced from wk 3 onwards when the rumen pH was lower than 5.6 for more than 180 min/d. Similar to grain-induced SARA, in this study SARA increased rumen LPS. However, this increase was not accompanied by feed intake depression, and increases in LPS and in the acute phase proteins serum amyloid-A (SAA), haptoglobin (Hp), and LPS-binding protein (LBP), in peripheral blood. This suggests that factors other than low rumen pH and increased free rumen LPS are responsible for the inflammatory response seen during grain-induced SARA. These factors might include rumen bypass starch, which has potential to alter microbiota and LPS release in the hind gut.

Table 1.

Item	Wk 1	2	3	4	5	6	P-value
Diet							
Alfalfa hay, % DM	50	42	34	26	18	10	
Alfalfa pellets, % DM	0	8	16	24	32	40	
DMI, kg/d	16.9^{c}	19.5^{b}	21.9^{a}	22.1^{a}	23.5^{a}	23.7^{a}	<0.01
Rumen parameters							
Time < pH 5.6, min/d	112^{c}	174^{c}	268^{b}	558^{a}	510^{a}	447^{ab}	<0.04
Rumen LPS, EU/ml	38,900^{b}	38,000^{b}	34,600^{b}	61,700^{ab}	120,200^{a}	162,200^{a}	<0.01
Blood parameters							
LPS, EU/mL	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
LBP, µg/ml	7.2	4.2	3.4	3.9	5.1	2.6	0.09
Hp, µg/ml	56^{a}	34^{ab}	27^{b}	28^{b}	21^{b}	12^{c}	<0.01
SAA, µg/ml	23.1^{a}	12.3^{ab}	7.8^{b}	12.3^{ab}	9.6^{b}	6.9^{b}	<0.01

Key Words: Subacute Ruminal Acidosis, Plasma LPS, Acute Phase Response

902 Particle analysis of swallowed hay boluses varying in chop length. I. Schadt*[1], M. Caccamo[1], J. D. Ferguson[2], G. Azzaro[1], R. Petriglieri[1], P. Van Soest[3], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*University of Pennsylvania, School of Veterinary Medicine*, *Kennett Square*, [3]*Cornell University*, *Ithaca, NY*, [4]*D.A.C.P.A. University of Catania*, *Catania, Italy*.

Sufficient long fiber is critical in dairy rations to maintain normal rumen function. Effective NDF has been defined as material retained on a 1.18 mm sieve. Mertens further refined this to describe physically effective NDF as material that maintains acceptable rumination and milk fat content. Dietary particle size is altered as a cow chews to process feed material for swallowing. This project examined the long particle distribution in a swallowed bolus from hay of variable lengths. Three nonlactating, rumen fistulated cows, adapted to Loietto grass hay, were held off feed for 12 hours, rumens evacuated, and offered 0.25 kg of long or chopped hay. Swallowed boli were manually retrieved from the reticulo-rumen at the esophageal orifice. Treatments were as follows: 1) long hay, 2) hay cut to 5 cm lengths, 3) chopped hay retained on a 1.91 cm screen, 4) chopped hay which passed a 1.91 cm screen but retained on a .787 cm screen, and 5) chopped hay passing a .787 cm screen but retained on a .127 cm screen. Long particles in hay treatments and boli were defined as those retained on a 1.6 mm screen. Mean long particle size and distribution in hay treatments and boli were defined after Licitra et. al. (J. Anim. Sci. 83:supplement 1, 252). Mean long particle sizes (mm, (sd)) for treatments were as follows (superscripts differ by p<.05): 1) long hay, not determined, 2) 46.2^{a} (.6), 3) 51.0^{b} (.9), 4) 25.8^{c} (.3), and 5) 9.8^{d} (.1). Mean long particle

bolus sizes (mm, (sd)) by treatments were as follows (superscripts differ by p<.05):1) 9.1[a] (.1), 2) 9.1[a] (.1), 3) 9.5[b] (.1), 4) 9.0[a] (.1), and 5) 7.8[c] (.1). Chewing altered particle distribution so hay particles which were retained above a screen size of .787 cm were rather similar in mean size and distribution when swallowed. Dietary hay particles smaller than .787 cm were smaller in the swallowed bolus.

Key Words: Hay Particles, Bolus Particles, Dairy Cattle

903 Rumen function and lameness in pasture based dairy cows of the South Island of New Zealand. J. Gibbs*, J. Laporte-Uribe, C. Trotter, and J. Noel, *Dairy Science Group, Agriculture and Life Sciences, Lincoln University*, *Canterbury, New Zealand*.

Dairying in the South Island (SI) of New Zealand is pasture based, commonly with large herds (>600) and intensive pasture management with high feed quality across the lactation season. Lameness in this system is a dominant health and welfare concern, and a common industry explanation is sub-clinical laminitis due to the high sugar and low fibre of the pastures. This project sought to establish the incidence and profile of lameness in SI herds, and the characteristics of rumen function and any role it has in lameness, in SI systems. All lameness on 43 representative SI farms (>32000 cows) in 2005/06 was recorded. All cases had affected claw, diagnosis, and treatment recorded in a diary. Monthly pasture samples were obtained. Detailed ancillary information on farm management, infrastructure, nutrition, production, reproduction and lameness reduction strategies was obtained. Five cows in one herd were rumenally fistulated. For 96 h periods across the season, rumen pH and temperature were logged every 15s via indwelling probes. Rumen samples were obtained twice weekly for metabolite and microbiota assessment. The mean lameness incidence recorded was >22%. Pasture quality was very high with little variation across the season. Lameness was positively associated with herd size and pasture quality, but not infertility. Recorded pH values were low: up to 80, 20 and 10% of some trial periods were <6.0, <5.5, and <5.0, respectively. A daily pH trough of 5.0-5.5 was recorded in most cows across the season. Lactic acid was absent or <1 mmol/L, while volatile fatty acid profiles were typical of grass fed ruminants. Microbial profiles suggested major sub-populations changed little across the season. No clinical or production observations suggested rumen dysfunction. Conclusions: The incidence of lameness in 2005/06 in the SI appears higher than previously reported in similar systems in NZ and Australia. Several potential regional influences are suggested: large herd size, nutrition, and management. Rumen function in high production SI cows appears atypical, with marked diurnal pH trough and flux, yet stable metabolite production and microbiota.

Key Words: Dairy Pasture, Lameness, Rumen pH

904 Effect of lifecycle stage of dairy cattle on serum mineral concentrations. D. R. Bremmer[1], R. H. Schulte[2], and M. T. Socha*[3], [1]*Vita Plus Corporation*, *Madison, WI*, [2]*Modified Genetics*, *Marshfield, WI*, [3]*Zinpro Corporation*, *Eden Prairie, MN*.

Blood samples were obtained from Holstein cows on a commercial dairy to determine lifecycle stage effect on serum mineral concentrations. Samples, collected on 2 d, approximately 8 wk apart, were obtained from 40 cows in first 2 wk of dry period (Dry), 43 cows less than 2 wk prior to calving (Prefresh) and 40 cows in first wk of lactation (Postfresh). Effects included in data analysis model were sampling time and lifecycle stage, with significant period effects noted at P≤0.05. Serum concentrations of non-heme Fe and Mg were lower, Postfresh than in Dry and Prefresh periods (121.0 vs. 156.9, 158.0 µg/dL; 21.7 vs. 23.3, 23.5 µg/mL), while serum concentrations of Mo and Cu were higher, Postfresh than in Dry and Prefresh periods (24.9 vs. 4.9, 4.8 ng/mL; 0.84 vs. 0.70, 0.66 µg/mL). More Postfresh cows had less than adequate serum concentrations of non-heme Fe and Mg than Dry and Prefresh cows (42.5 vs. 2.5, 2.3%; 37.5 vs. 7.5, 7.0%), while more Prefresh and Dry Cows had less than adequate serum concentrations of Mo and Cu than Postfresh cows (100, 100 vs. 7.5%; 22.5, 32.6 vs. 2.5%). Serum Mn concentrations were higher in the Prefresh period than in the Dry period (1.48 vs. 1.20 ng/mL, P<0.05), with 82.5, 58.1 and 75.0% of Dry, Prefresh and Postfresh Cows having less than adequate Mn serum concentrations. Serum Co concentrations were highest, Prefresh, followed by Dry and Postfresh periods (1.18, 0.91 and 0.74 ng/mL). More Dry and Postfresh cows had less than adequate serum Co concentrations than Prefresh cows (15.0, 15.0 vs. 0.0%). Serum Zn concentrations were highest in Dry period, followed by Prefresh and Postfresh periods (1.77 vs. 1.65 vs. 1.34 µg/mL) while serum Se concentrations were highest, Postfresh, followed by Dry and Prefresh periods (103.7 vs. 91.8 vs. 82.4 ng/mL). All cows had adequate serum Se concentrations and only 2.5% of Postfresh cows had less than adequate serum Zn concentrations. Results of this survey indicate that cows on this dairy are most prone to Fe and Mg deficiencies, Postfresh, Cu and Mo deficiencies in Dry and Prefresh periods and Mn deficiencies in Dry, Prefresh and Postfresh periods.

Key Words: Serum, Dairy Cattle, Minerals

905 Phosphorus balance in dairy cows during lactation. J. A. Elizondo Salazar*[1], D. B. Beegle[1], J. D. Ferguson[2], and Z. Wu[2], [1]*Pennsylvania State University*, *University Park*, [2]*University of Pennsylvania*, *Kennett Square*.

Phosphorus balance in lactating cows was determined. Thirty multiparous Holsteins were fed 0.32% P during the dry period and assigned to one of the following three dietary treatments for the subsequent lactation: 0.36% P throughout the lactation (0.36-0.36-0.36), 0.36% P for 30 wk followed by 0.29% P for 14 wk (0.36-0.36-0.29), and 0.43% P for the first 10 wk, 0.36% P for the second 10 wk, and 0.29% P for the last 14 wk (0.43-0.36-0.29). Phosphorus balance was determined during wk -4 to -1, 9 to 13, 19 to 23, and 38 to 42 of lactation as intake P - fecal P - urinary P - milk P, when appropriate. While not different among treatment groups, the balance was negative for wk -4 to -1 and 9 to 13, became positive by wk 19 to 23, and showed a clear deposition during wk 38 to 42 for all groups. Consistent with the changes in P balance, plasma osteocalcin, a bone formation maker, increased during most of lactation, averaging 6.9, 9.4, 12.0, and 5.9 ng/ml for all groups, and plasma pyridinolin, a bone resorption marker, decreased, averaging 3.1, 2.8, 2.6 and 2.4 pg/ml, for wk -4 to -1, 9 to 13, 19 to 23, and 38 to 42, respectively. Rib bone P averaged 10.7 and 12.3% for all groups during wk -4 to -1 and 38 to 42, respectively, also consistent with the P balance data. Results suggest that cows mobilized P from bone during the dry period toward parturition and during early lactation, and restored P toward the end of lactation; this pattern of P metabolism did not differ when different amounts of P were fed. (Partially funded by Pennsylvania Department of Agriculture)

Table 1. Phosphorus balance (g/d)

Week	0.36-0.36-0.36	0.36-0.36-0.29	0.43-0.36-0.29	SEM	*P* Constant vs. varied P[1]	P changed once vs. twice[2]
-1 to -4[4]	-7.9	-7.9	-7.9	...	...	...
9 to 13	-3.0	-4.4	-0.5	4.3	0.55	0.82
19 to 23	0.6	1.2	3.9	3.8	0.52	0.92
38 to 42	4.4	7.1	8.6	3.1	0.49	0.57

[1]0.36-0.36-0.36 vs. 0.36-0.36-0.29 and 0.43-0.36-0.29. [2]0.36-0.36-0.29 vs. 0.43-0.36-0.29. [3]All groups received 0.32% P during the dry period.

Key Words: Dairy Cows, Phosphorus Requirement, Bone Phosphorus

906 Effect of 2-hydroxy-4-(methylthio) butanoic acid isopropyl ester on milk production and composition of high yielding lactating Holstein dairy cows. R. H. Phipps*[1], A. K. Jones[1], C. K. Reynolds[1], D. I. Givens[1], P-A. Geraert[2], and C. Richard[2], [1]*University of Reading*, *Reading, UK*, [2]*Adisseo*, *Commentary, France.*

Sixteen-multiparous, high yielding Holstein cows (72 ± 16 DIM; 45.0 ± 2.96 kg milk/d) were used, in a 4 × 4 Latin square design to determine the effect of 2-hydroxy-4-(methylthio) butanoic acid isopropyl ester (Metasmart®; 4.2 g/kg concentrate DM) and dietary crude protein (CP) content (low: 14.7 % vs. standard: 16.9 %, DM fed) on milk yield and composition in a 2 × 2 factorial design. All cows received ad libitum a TMR with a 1:1 forage to concentrate ratio (DM basis) and diets contained an estimated metabolizable lysine and methionine content of 6.7 and 1.8 % of metabolisable protein, respectively. Data for DM intake (DMI), milk yield and composition were obtained in wk 4 of each period. No significant treatment effects on DMI (24.7 ± 0.52 kg/d) were noted. There was a significant interaction between dietary CP and Metasmart® for milk yield, 3.5% fat-corrected milk (FCM) yield and yield of milk protein. Metasmart® increased milk yield by 0.5 kg/d (P < 0.05), 3.5% FCM yield by 1.3 kg/d (P < 0.05) and milk protein yield by 65 g/cow/d (P < 0.001) with 16.9 % dietary CP, but had no effect in the 14.7 % CP diet. Feeding Metasmart® increased milk protein content by 1.1 g protein/kg (P < 0.001), with values of 1.3 and 0.8 g/kg noted for standard and low CP diets, respectively. Although numerically higher at both levels of dietary CP, there was no significant effect of Metasmart® on milk fat concentration. In conclusion, feeding Metasmart® increased 3.5 % FCM yield and milk protein content after only 3 wks of supplementation. In addition, the effect of Metasmart® on milk protein and 3.5 %FCM yield was only observed at the standard level of dietary CP, suggesting other factors limited the response to Metasmart® when dietary protein supply was restricted.

Key Words: Dairy Cows, Milk Production, Amino Acid Supplement

907 Transport of 2-hydroxy-4-methyl-thio-butanoic isopropyl ester (HMBi) across rumen epithelium *in vitro*. W. Heimbeck*[1] and G. Breves[2], [1]*Degussa GmbH*, *Hanau, Germany*, [2]*Institute for Physiology, School of Veterinary Medicine*, *Hannover, Germany*.

Objective was to evaluate the potential of rumen epithelium to transport HMBi using Ussing chambers. Rumen tissues were obtained from a nearby slaughter house, stripped from the muscle layer, placed in buffer and gassed with 95:5 O2:CO2 before mounting. Two levels of HMBi (0.78 and 1.56 mg per ml) and 2 incubation times (120 and 180 min) were used in 12 chambers with 3 replicates with an exposed surface of 2 cm2. Four separate experiments were conducted (n= 48). Concentrations of HMBi and methionine hydroxy analog (HMB) were measured by HPLC in mucosal and serosal buffers. Data are expressed as % of added HMBi. Differences were assessed with GLM of SAS. Model included terms for experimental day, HMBi level, incubation time, sampling side and interactions. Adding the HMBi-buffer mixture to the mucosal side caused an immediate release of HMB (mean = 6.3%). Breakdown of HMBi to HMB at 0 time may be due to hydrolysis reactions in buffer or reactions at epithelial surface. A small but consistent amount of HMBi (mean 0.58%) was transferred to serosal buffer. A larger amount of HMB (8.94%, P<.01) was also isolated (about 0.06% per minute). Evidence of HMB in serosal buffer may indicate HMBi transfer and subsequent hydrolysis. Increasing dose elevated quantity but decreased % of dose appearing as HMB on the serosal side (10.54% and 7.33%, P<.01). Increasing incubation time increased the amount of HMB in the mucosal side buffer (34.0% at 120 min versus 43.4% at 180 min, P<.01) and decreased the amount of HMBi (37.9% at 120 min versus 28.1% at 180 min, P<.01). Small differences among experiments for recovery of HMB and HMBi were observed (MSD= 4.18 and 1.84 mucosal; 4.29 and 0.28 serosal). These data indicate that, if HMBi is transported actively, the system may be readily saturated. Alternatively, HMBi may move across the epithelium by diffusion. From these *in vitro* experiments, there is no evidence that rapid increases in blood HMB in response to HMBi intake are due to ruminal absorption.

Key Words: HMBi, Rumen Epithelium

908 Responses of rumen and blood metabolites of Holstein dairy cows to propylene glycol during frequent feeding. Y.-H. Chung*, C. M. Martinez, N. E. Brown, T. W. Cassidy, and G. A. Varga, *Dairy and Animal Science, Pennsylvania State University*, *University Park*.

The objective of the present experiment was to study the metabolic adaptation of Holstein dairy cows in response to propylene glycol (PG) when provided under different methods of delivery. By providing the same amount of pure PG, methods of delivery of PG assessed were: (1) control: no PG, (2) oral-drench: 226.8 ml (8 oz) of liquid PG (100% purity) oral drenched, (3) rumen-drench: 348.9g of dry PG (65% purity) drenched via rumen cannula, and (4) mixed: 348.9g of dry PG mixed into the TMR. Eight multiparous rumen cannulated Holstein dairy cows (DIM = 204 ± 104 SD) were fed PG for 4 d in a replicated 4 × 4 Latin square design with 14-d periods. On the last day of each period, cows were fed every 2 h to minimize postprandial effects. Blood was serially sampled from the jugular vein immediately before and for 4 h after PG administration. Rumen contents were serially sampled hourly for 4 h via the rumen cannula. Feed intake and milk yield were not affected by PG. Percentage of milk lactose was significantly increased by PG, across all methods tested in this experiment. The concentration of acetate was significantly decreased and propionate was significantly increased by PG (21.9 vs. 24.4 mol/100mol for control vs. PG treatments), regardless of delivery method. Concentration of butyrate was significantly decreased by PG

drench, either via oral or ruminal drench. Production of total VFA however was not statistically altered by PG. Serum insulin peaked significantly higher and more rapidly for cows receiving PG via drenching but not as a part of the TMR. Plasma glucose, however, tended to peak higher and more rapidly for cows receiving PG, regardless of delivery method. Results showed that rumen and blood metabolites responded similarly to liquid or dry PG drench indicating that top dressing dry PG is as effective as oral drenching liquid PG. Feeding dry PG as a part of the TMR during frequent feeding significantly altered the rumen profile toward a more glucogenic environment without stimulation of insulin.

909 Glucose minimal modeling in lactating dairy cows. R. C. Boston*[1], J. R. Roche[2], and P. J. Moate[1], [1]*University of Pennsylvania*, *Kennett Square*, [2]*University of Tasmania*, *Burnie, Tas, Australia*.

Quantification of the kinetics of glucose metabolism in lactating dairy cows may have application in elucidating the factors that control milk production or are involved in the etiology of metabolic diseases such as ketosis, fatty liver disease and downer-cow syndrome. For more than twenty years, researchers in the field of diabetes have used the Intravenous Glucose Tolerance Test (IVGTT) in humans, coupled with Bergman's non-linear "minimal model" (MinMod) to derive a rich set of parameters to describe the interaction between blood glucose and insulin. These parameters include: Glucose effectiveness (S_g), a first order rate constant describing its disappearance from blood, and Insulin sensitivity (S_I), which represents the capacity of insulin to promote the disposal of glucose from blood. Although more than 700 publications in human research have used the well-documented and carefully standardized IVGTT protocol and minimal modeling methodology, few studies in ruminant nutrition have used this approach. This investigation examined the capability of the standard (no insulin injection) IVGTT coupled with minimal modeling to obtain identified estimates of S_g and S_I in lactating cows. Ten lactating cows of diverse genetic origin and fed a wide range of diets, underwent a standard IVGTT with blood sampled at 0, 2, 4, 6, 8, 10, 12, 15, 18, 20, 23, 26, 30, 35, 40, 50, 60, 90, 120, 150, 180, 210, and 240 minutes. Plasma was measured for glucose and insulin. Minimal model analysis was conducted using MINMOD Millennium. The median, minimum and maximum estimates for S_g [% min^{-1}] were: 2.25, 1.12 and 3.44 and for S_I [10^{-4}(mU/L)$^{-1}$.min^{-1}], the corresponding estimates were 12.9, 8.7 and 17.1. In all individual cows, S_g and S_I were well identified with coefficients of variations less than 5%. The median estimate 2.25 for S_g is similar to the value of 2.2 reported for humans, but the median value of 12.9 for S_I in cows is surprisingly substantially higher than the value of 2.0 in humans. These findings suggest that glucose minimal modeling has great potential application in ruminant nutrition research.

Key Words: Glucose Effectiveness, Insulin Sensitivity, Minimal Model

Ruminant Nutrition: Lipid Supplementation

910 A decade of research developments in ruminant nutrition at the University of Wyoming. B. W. Hess*, *University of Wyoming*, *Laramie*.

Research efforts have focused on nutritional management practices to improve production efficiency of forage–fed ruminant animals, with primary emphasis on strategic supplementation regimens and secondary interest in alternative forage systems. The research program consists of three primary foci: 1) dietary lipids for ruminant animals; 2) protein nutrition of ruminant animals; and 3) the use of alternative forage crops and cropping methods in ruminant animal production systems. Interest in dietary lipids stems from the potential to alter fatty acid composition of food products derived from ruminants and the possibility to increase reproductive performance of ruminants through provision of supplemental vegetable oil. Investigations span from evaluating effects of supplemental lipids on site and extent of digestion to characterizing fate of fatty acids during metabolism and subsequent responses within various tissues and by the whole animal. Results of those endeavors suggest that vegetable oil may be added to forage–based diets at 3% of total DMI, tissue composition of fatty acids generally reflect fatty acids made available to the animal after ruminal biohydrogenation, and feeding cracked high–linoleate safflower seeds to beef cows during early lactation may have deleterious effects on reproduction and immune response by the suckling calf. The likelihood of livestock experiencing limited DMI in many range production systems has led to exploration of range management practices to enhance rangeland forage productivity and quality. Additionally, an interest in identifying specific nutrients involved with mediating various physiological responses within the animal has led to investigations centered on assessing essential AA status in ruminants fed limited amounts of roughage. An animal protein–based supplement has been developed to balance intestinal supply of essential AA in ruminants fed limited amounts of roughage. The research program is becoming more integrated as nutritional evaluations of rangeland forages indicate that strategic supplementation with lipids or protein may be warranted.

Key Words: Forages, Ruminants, Supplementation

911 Effect of dietary fish and soyoil supplementation on muscle fatty acid concentrations and oxidative lipid stability in beef cattle. D. A. Kenny*[1], J. P. Kelly[1], F. J. Monahan[1], and A. P. Moloney[2], [1]*University College Dublin*, *Dublin 4, Ireland*, [2]*Teagasc Grange Research Centre*, *Co. Meath, Ireland*.

The objective of this study was to examine level and duration of soyoil (SO) and fishoil (FO) supplementation on muscle fatty acid (FA) concentration and lipid oxidative stability in beef cattle. Young beef bulls (n=48) were blocked on age, bodyweight, and breed and individually offered ad libitum one of four isolipid and isonitrogenous diets for 100 days. All diets consisted of 10:90 (DM basis) straw:concentrate. The concentrates contained one of: (i) 6% SO (CON); (ii) 6% SO + 1% FO (FO1); (iii) 6% SO + 2% FO (FO2) or (iv) 8% palmitic acid for first 50 days and 6% SO + 2% FO for latter 50 days (FO2(50)). Palmitic acid was added to CON and FO1 to give 8% added lipid. The SO had 53% linoleic acid while the FO had 39%