were not affected by a 3-way or diet × time interaction. Results suggest that heat tolerance in steers can modify physiological responses to endophyte-infected tall fescue.

Key Words: Fescue Toxicosis, Cattle Breeds, Heat Tolerance

492 The effect of supplemental feed at parturition in the rainy season on hair sheep ewe performance in the tropics. R.W. Godfrey*, W. Gonzales, and R.E. Dodson, *University of the Virgin Islands, AGricultural Experiment Station, St. Croix.*

St. Croix White and Barbados Blackbelly hair sheep ewes were used to evaluate the effect of supplemental nutrition around lambing on ewe and lamb performance during the wet season on St. Croix. Beginning 14 d prior to expected day of lambing (day 0) and for 21 d postpartum, 11 ewes were fed a pelleted complete ration (17% crude protein) at a level to provide 150% of the nutrient requirements, in addition to grazing guinea grass pasture (FEED). Twelve ewes grazed pasture only (CONTROL). This study was conducted during October through January. Total rainfall during this time was 212 mm and forage dry matter ranged from .77 to 2.49 MG/ha. The 24-hr milk production of all ewes was measured on days 7, 21, 35, 49 and 63. Ewes were given 1 IU of oxytocin (i.v.) and milked by hand and separated from their lambs. Four hours later ewes were hand milked again, using oxytocin, and the milk from the second milking was weighed to determine 24-hr milk production. Ewes were exposed to sterile rams equipped with marking harnesses to detect estrus during the postpartum period. Lambs were weaned at 63 d of age. Data were analyzed by SAS using treatment and days postpartum as main effects. The CONTROL ewes lost a higher percentage ($P < .05$) of their pre-lambing weight during lactation than FEED ewes. There was no difference ($P > .10$) in milk production between FEED and CONTROL ewes. The time to first postpartum estrus was less ($P < .03$) in FEED than in CONTROL ewes (33.0 ± 2.5 vs 41.1 ± 2.4 d, respectively). Litter birth weight was similar ($P > .10$) for FEED and CONTROL ewes (4.2 ± .5 vs 4.9 ± .4 kg, respectively). Lamb weaning weight was not different ($P > .10$) for lambs raised by FEED or CONTROL ewes (17.3 ± .9 vs 15.8 ± .8 kg, respectively). There was no difference ($P > .10$) in ADG of lambs in the FEED or CONTROL groups (222.1 ± 13.6 vs 200.4 ± 11.9 g/d, respectively). Supplementation of hair sheep ewes around parturition during the rainy season in the topics does not appear to enhance ewe or lamb production traits.

Key Words: Sheep, Lamb, Milk Production

ASAS/ADSA Ruminant Nutrition: Fat Nutrition/Feed Intake

493 Effect of feeding different sources of supplemental fat on the performance of lactating buffaloes. H. Nawaz, M. Abdullah*, and G. Mohiuddin, *University of Agriculture, Faisalabad, PAKISTAN.*

Four early lactating Nili-Ravi buffaloes were fed four experimental diets either containing no added fat (control) or tallow, poultry fat or mustard oil at 3 per cent of diet dry matter in a 4 x 4 Latin Square Design. The intakes of DM, and CP decreased ($p<0.05$) in buffaloes fed diet supplemented with tallow or poultry fat compared to either control or diet containing mustard oil. Intake of NEL were significantly higher in buffaloes consuming mustard oil versus those fed the control diet or diets containing tallow or poultry fat (21.4 vs. 19.6 19.0 19.4 Mcal/d, respectively). Average daily production of milk and 4 percent FCM, was significantly higher in buffaloes fed diets containing supplemental fat (13.0, 20.6, kg/d) vs. in those fed the control diet (10.6, 16.0, kg/d), respectively. Milk fat percentage was significantly higher (8.38 %) in buffaloes consuming diet supplemented with tallow than in those fed diet supplemented with poultry fat (7.90 %), mustard oil (7.45 %) or control diet (7.41 %). The concentrations of C8:0 to C16:1 fatty acids were lower (39.16 vs. 59.13 %) while those of C18:0 to C20:0 were higher (59.69 vs. 40.04 %) in milk fat of buffaloes fed diets containing supplemental fat than in those fed the control diet. Total solids contents were higher for buffaloes consuming tallow-supplemented diet (17.75 %) versus those fed the control (16.47 %), poultry fat (17.27 %) or mustard oil (16.56 %) supplemented diets. The GE of milk (Kcal/kg) and total GE of milk (Mcal/d) were higher for buffaloes consuming the tallow-supplemented diet (1221 and 15.7) compared with the control (1063 and 11.2) or diet containing mustard oil 1074 and 13.7). Digestibility of DM was significantly higher in animals fed diet-containing tallow (71.3 %) than in those fed the control diet (69.9 %). The digestion coefficient of EE increased significantly in buffaloes fed diets containing tallow (75.9 %) and poultry fat (73.8 %) versus the control (70.2 %) or the diet containing mustard oil (69.4 %). Significantly lower ratios of acetate to propionate were observed in buffaloes fed different fat sources (2.6) than the control diet (3.18).

Key Words: Supplemental fat, Buffaloes, Milk production, Digestibility

494 Effect of feeding different levels of supplemental tallow on the performance of lactating buffaloes. M. Abdullah*, H. Nawaz, and G. Mohiuddin, *University of Agriculture, Faisalabad, PAKISTAN.*

Four early lactating Nili-Ravi buffaloes were fed four experimental diets containing 0, 2, 4 or 6 % tallow in a 4 x 4 Latin Square Design. The intakes of DM, OM, CP, ADF and NDF decreased ($p<0.01$) but intake of EE ($p<0.01$) and DE ($p<0.05$) increased with increasing levels of tallow in the diets. Intake of NEL did not differ significantly with varying levels of supplemental tallow. Daily milk yield increased (from 11.0 to 13.2 kg/d, $p<0.01$), production of 4 percent FCM, SCM, and ECM increased quadratically ($p<0.05$) with the increasing level of tallow in the diets. Milk fat content and total milk fat increased respectively with increasing levels of tallow. The proportion of C8:0 to C16:1 fatty acids decreased (53.66 to 35.52 %), whereas, concentration of C18:0 to C20:0 increased (44.93 to 62.84 %) in milk fat of buffaloes fed diets containing different levels of tallow. No differences were observed in concentration of milk protein and lactose among control and those fed different levels of tallow. Total solids contents increased (16.45 to 17.67 %, $p<0.05$) but SNF percentages did not vary with varying levels of tallow. The GE of milk (Kcal/kg) increased (1096 to 1160, $p<0.01$) with increasing levels of tallow in the diets. Energetic efficiency of milk production improved in a quadratic ($p<0.05$) manner with 2, 4 and 6 percent tallow, highest (47.6 %) with 4 % supplemental tallow. The digestibility of DM and OM was 66.4 & 63.4, 67.9 & 64.9, 70.6 & 67.2 and 67.4 & 62.7 %, ($p<0.05$) with 0, 2, 4 and 6 % supplemental tallow in the experimental diets, respectively. The digestibility of CP did not differ, while that of EE improved (68.2 to 74.5 %, $p<0.01$). The blood pH and concentration of glucose did not vary significantly due to varying levels of tallow in the diets. The concentrations of cholesterol, triglycerides and blood lipids increased ($p<0.01$) with increasing levels of tallow. A linear ($p<0.01$) decrease in acetate to propionate ratio was observed with increasing levels of tallow in the diets (3.24 to 2.66, $p<0.01$).

Key Words: Supplemental tallow, Buffaloes, Milk production, Digestibility

495 A two-year study measuring the reproductive performance of dairy cows fed soybeans. A. Mowrey*, J. N. Spain, M. C. Lucy, M. R. Ellersieck, and K. L. Fritsche, *University of Missouri - Columbia.*

Two studies were conducted during two consecutive years to evaluate the effects of fat supplementation on milk production and reproduction in dairy cows. Year 1 (Y1) utilized a randomized complete block design with 84 early lactation dairy cows fed a control diet or a diet with either raw cracked soybeans or a rumen inert fat product added. In Year 2 (Y2), 68 early lactation dairy cows were fed a control diet or one of three diets containing increasing amounts of soybeans. Cows received treatments beginning two weeks post-calving and were fed assigned treatment until animals were inseminated (Y1) or until 70-d post calving (Y2). Milk yield, milk components, intake, body weight and plasma progesterone were measured. During Y1, pretreatment and experimental milk yield was significantly higher for control and soybean-fed cows ($P \leq 0.05$). Fat-corrected milk yield was not different among diets. Dry matter intake followed the same trend as milk yield, averaging less for cows fed inert fat; as a percent of body weight these changes were not significant. Plasma stearic acid increased following feeding of the diets containing supplemental fat. Progesterone concentrations changed little due to dietary treatments. Ultrasonagraphic measures of follicular

and corpus luteum growth during Y1 were similar for cows fed different diets. During Y2, production parmeters of milk yield and DMI were unchanged. Milk protein percentage decreased significantly as level of soybeans increased, although yield of milk protein was similar. Plasma cholesterol increased from day one until the end of the study and increased as fat was added to the diets. Plasma stearic and linoleic acid was highest in cows fed the diets containing soybeans. Percentage of cows in estrus after estrous synchronization was 87.2% (Y1) and 71% (Y2) and conception rate to the synchronized estrus was 41.2% (Y1) and 38% (Y2), both were similar across diets. In summary, raw soybeans were fed to lactating dairy cows without significant decreases in production, ovarian activity, or conception rate.

Key Words: Dairy cows, Reproduction, Plasma fatty acids

496 Interactions of Rumensin premix and diet on milk fat percentage in lactating dairy cattle.

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A total of 91 Ontario Holstein dairy herds were surveyed in the spring of 1999 for general lactating cow ration information and the use of Rumensin® premix in their lactating cow diets. In addition, herds were asked to submit wet forage and TMR samples to the Ontario Veterinary College for evaluation of particle size. All herds were enrolled in Ontario Dairy Herd Improvement (DHI) milk recording. Four DHI tests near the time of the feed sampling (March to June) were selected and pooled to calculate the herd mean milk fat percentage. To avoid the confounding effects of stage of lactation, the herd mean milk fat test was calculated for only those cows that were between 100 and 200 days in milk at the time of each DHI test.

Of the 91 herds in the study, 80 fed haylage, 79 fed corn silage, and 58 herds fed a TMR. There were 15% of haylage samples, 14% of corn silage samples and 42% of TMR samples that were below the lower guidelines for the top screen of the Penn State particle separator. These were classified as low fiber samples. In total there were 33 herds that were not using Rumensin in the lactating cow diet and 58 herds that were. Concentrations of Rumensin in feed ranged from 8 to 23 ppm, with a median of 14 ppm. Significant interactions of diet and Rumensin with milk fat are illustrated in the table below.

There appears to be important dietary factors that may allow the prediction of milk fat response to Rumensin in dairy herds. Rations that are deficient in effective fiber appear more susceptible to milk fat depression with Rumensin. In addition, low NSC (< 40.2) diets were more susceptible to milk fat depression with Rumensin than those diets high in NSC (≥ 40.2). Further research is required to fully assess and test these ration interactions with Rumensin.

Ration Parameter	Rumensin in the Ration		p-value
	No	Yes	
TMR	3.61	3.39	0.007
Component	3.62	3.58	0.580
Low Fiber TMR	3.68	3.36	0.001
Normal Fiber TMR	3.60	3.44	0.060
High NSC	3.59	3.58	0.920
Normal NSC	3.75	3.40	0.001

Key Words: Monensin, Milk fat, Effective fiber

497 Effect of supplemental fat and monensin on ruminal fermentation in dual-flow continuous cultures.

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Approximately 700 ml of rumen inoculum was obtained from a mature lactating Holstein and incubated in fermentors with a fractional liquid dilution rate of 6.3%/h. Basal diet comprised of alfalfa pellets (7.5g) offered twice daily. Two treatments were assigned to four fermentors (n=2) for a total period of 8 d including 2 d of adaptation to diet and fermentor. Treatments consisted of: 1) Monensin (30 ppm; 450 μg/d) administered for 2 d followed by 4 d of the addition of both monensin and fat (linoleic acid; .450g/d), and 2) Linoleic acid (.450 g/d) added for 2 d followed by 4 d of the addition of both fat and monensin (450 μg/d). Data were analyzed as repeated measures. Both treatments resulted in a lower proportion of acetate and a higher proportion of propionate in ruminal cultures. However the change in VFA pattern was greater when monensin was added prior to the fat (treatment 1). During the control period C18:0 comprised more than 60% of the long chain fatty acids in ruminal cultures. Treatment 1 resulted in a lower ($P < .01$) C18:0 content (25.8%) and a higher ($P < .05$) C18:1 content (28.4%) compared with 55.4% and 17.9%, respectively for treatment 2. The concentration of C18:2 in cultures during the control period averaged 1.4%. Treatment 1 increased ($P < .01$) C18:2 content which averaged 19.3% compared to the 5.5% observed in cultures receiving treatment 2. The presence of linoleic acid prior to the addition of monensin minimized the effect of the ionophore on ruminal biohydrogenation.

Key Words: Fat, Ionophore, Rumen fatty acid

498 Formulating high fat rations for lactating dairy cattle according to a ratio of metabolizable protein to net energy.

V. Pattarajinda*, M. A. Froetschel, H. E. Amos, D. Kumar, and A.A. Gautreaux, *The University of Georgia, Athens.*

Four Holstein cows in mid lactation were used in a 4x4 Latin square designed experiment with a 2x2 factorial arrangement of treatments to determine if higher levels of fat could be more effectively utilized when a ratio of metabolizable protein (MP) to NE_L was maintained. Four diets were formulated to contain : 1) 45% RUP and 7.6% fat (HRHF), 2) 45% RUP and 3.2% fat (HRLF), 3) 35%RUP and 7.6% fat (LRHF), and 4) 35% RUP and 3.2% fat (LRLF). Whole cottonseed supplied a basal level of dietary fat (5%) and calcium soaps of fatty acids were used as of additional fat. Soybean meal was used as the main protein supplement for the 35 % RUP diets and a blend of heat- processed soybean meal, fish meal, blood meal and dried distillers grains were used as sources of RUP for the 45% RUP diets. Feed was offered as a TMR and contained approximately 50% sorghum silage. The metabolizable protein (MP) / NE_L ratio was estimated as 75.7, 83.8, 67.6,and 75.6 g of MP/ Mcal of NE_L in HRHF, HRLF, LRHF, and LRLF, respectively. Intake (% BW) of cattle fed the HRHF diet was depressed 4.7 to 10.4% as compared to the other diets. Milk production was increased by 2.8% by feeding RUP and decreased 2.4% by feeding additional fat. Milk fat (%) was increased 5.5 % by feeding additional fat. Feeding RUP tended to decrease the digestion of DM (DMD) and NDF (NDFD) by 4.6 and 5.7%, respectively. Diet NE_L, predicted from apparent digestible energy, was 9.1% greater in diets with added fat. Efficiency of NE_L used for milk (EE milk) was decreased 11.9 to 13.9% when cattle were fed the lowest ratio of MP/ NE_L. Blood urea N (BUN) was increased 45.9% higher when cattle were fed diets higher in fat. There appears to be some advantages to maintaining a proper MP/ NE_L ratio when feeding high fat diets and encourages the use of this parameter when formulating rations.

Item	HRHF	HRLF	LRHF	LRLF	SEM	RUP P<	Fat P<	INT P<
DMI, kg/d	20.3	21.5	22.1	22.0	.8	.02	.14	.09
DMI, %BW	3.37	3.76	3.53	3.61	.05	.01	.88	.03
Milk, kg/d	28.7	29.6	28.0	28.7	.3	.02	.03	.73
Milk fat, %	3.72	3.57	3.9	3.65	.08	.17	.05	.67
Milk CP, %	2.79	2.83	2.77	2.85	.04	.95	.21	.67
DMD, %	64.1	63.3	65.5	68.0	1.4	.07	.58	.29
NDFD, %	58.3	55.2	59.3	61.0	1.8	.09	.69	.22
NE_L, Mcal/kg	1.74	1.65	1.84	1.63	.06	.51	.04	.37
EE milk, %	56.7	56.7	48.8	55.4	1.6	.02	.06	.03
BUN, mg/dL	19.4	12.8	20.3	14.3	.74	.16	.01	.71

Key Words: Metabolizable protein, Dietary fat, Dairy cattle

499 Effects of feeding different sources of neutral detergent-soluble carbohydrates supplemented with fat and propionate to heat stressed dairy cows. A. M. Akinyode*, M. B. Hall, J. P. Jennings, C. R. Staples, and C. J. Wilcox, *Univ. of Florida, Gainesville*.

The effects of different forms of energy supplementation on the lactation performance of heat stressed cows was evaluated. Thirty-two Holstein cows in mid-lactation were assigned to eight treatments in a 2 x 2 x 2 factorial, partially balanced incomplete Latin square design with three 21-d periods in which the last 7 days were used for sampling. The treatments consisted of citrus pulp- or hominy-based diets (C and H, respectively), with or without propionate supplementation from 0.73% of diet DM as Nutrocal® (P), and with or without fat supplementation from 0.6% of diet DM as Megalac® (F). Cows were fed individually in a freestall barn, with shade, but without additional cooling. Rectal temperatures (RT) and respiration rates (RR) were taken twice daily,and blood samples once daily on days 1,3, 5, and 7. Values reported are least squares means. Significance was declared at P<0.05. Main effects did not differ for body weight (BW), or morning and afternoon RR (MRR and ARR). Significant factors affecting ARR were milk yield and BW (R^2 = 0.39), and BW alone for MRR (R^2=0.23). P reduced morning RT (MRT), but not afternoon RT (ART). RT and RR were correlated (r=0.45). Decreased intake with P may have been due to dustiness of the product used and decreased palatability. In this study, the effects of treatments on animal performance were limited.

Item	C	H	-P	+P	-F	+F
DMI,kg/d	19.0**	20.6**	20.2*	19.4*	20.1	19.4
MRT°C	39.6	39.8	40.1*	39.3*	39.7	39.8
ART°C	39.5	39.4	39.4	39.4	39.4	39.5
Insulin,ng/ml	0.89	0.92	0.89	0.92	0.92	0.89
Plasma glucose,mg/dl	90.1	91.3	90.3	91.1	90.1	91.2
Milk yield,kg/d	22.1	23.2	23.5*	21.8*	22.3	22.9
Milk protein,kg/d	0.70	0.71	0.72	0.69	0.70	0.71
Milk fat,kg/d	0.81	0.82	0.87**	0.77**	0.82	0.82
MUN,mg/dl	16.1	15.6	16.1	15.7	15.3**	16.4**
Milk/DMI	1.22	1.17	1.24	1.15	1.14	1.24

**P < 0.05; *P < 0.10

Key Words: Heat Stress, Dairy Cows, Energy Supplements

500 An alternative approach to determine the efficiency of energy utilization for milk production in lactating dairy cows. E. Kebreab*[1], J. France[1], R.E. Agnew[2], and T. Yan[2], [1]*The University of Reading, Reading, United Kingdom,* [2]*Agricultural Research Institute of Northern Ireland, Hillsborough, United Kingdom*.

The current energy requirements system used in the UK for lactating dairy cows utilizes key parameters such as metabolizable energy intake (MEI) at maintenance (MEIm), the efficiency of utilization of MEI for (i) maintenance, (ii) milk production (k_l) (iii) growth (k_g), and the efficiency of utilization of body stores for milk production (k_b). Traditionally, these have been determined using linear regression methods to analyze energy balance data from calorimetry experiments. Many studies have highlighted a number of concerns over current energy feeding systems particularly in relation to these key parameters. Underlying these concerns could be the rigid acceptance of linear methods in analyzing energy balance data from dairy cows. Therefore, a database containing 456 individual cow records was created from centers with calorimetry facilities in the UK. Five functions were considered: the conventional 'broken-stick', two diminishing returns functions - the Mitscherlich and the rectangular hyperbola and two sigmoidal functions - the logistic and the Gompertz. Based on the definition of k_l as the ratio of milk energy derived from MEI to MEI directed towards milk production, zero energy balance (±5 MJ) were used to estimate regression parameters to determine MEIm, and k_l. Positive and negative energy balance data were used to estimate k_g and k_b, respectively. Values of 0.8 and 0.65 were obtained using all the functions for k_g and k_b, respectively, which were significantly different from previous reports of 0.6 for k_g and 0.84 for k_b. When all the data were pooled, the average k_l was 0.61. Non-linear analysis showed a decreasing value of k_l as feeding level above maintenance increases. Various factors affecting k_l were also analyzed. Lower k_l was obtained in experiments conducted after 1991, perhaps due to differences in the genetic merit of the cows. It also showed k_l to be influenced by forage type, forage:concentrate ratio, ADF content, and stage of lactation.

Key Words: Energy utilization, Dairy cows

501 Effects of dietary supplementation of rumen-protected CLA in dairy cows during established lactation. J. W. Perfield II*, G. Bernal-Santos, T. R. Overton, and D. E. Bauman, *Cornell University, Ithaca, NY*.

Specific isomers of conjugated linoleic acids (CLA) have anticarcinogenic properties (*cis*-9, *trans*-11 CLA), and reduce milk fat synthesis (*trans*-10, *cis*-12 CLA). Short-term studies have shown that abomasal infusion of CLA or dietary supplements of rumen-protected CLA can enhance CLA content and/or reduce fat content of milk. Our objective was to assess effects of CLA supplementation during established lactation. Thirty Holstein cows were blocked by parity and received either a supplement of 116 g of EnerG II (Bioproducts, Inc) (control) or 126 g/d of CLA supplement. Supplements were topdressed on the TMR. The CLA supplement provided 42.8 g/d of CLA in the form of rumen-protected calcium salts (donated by Agribrands Purina Canada Inc.). Predominant CLA isomers were: *trans*-8, *cis*-10 (9.2%), *cis*-9, *trans*-11 (25.1%), *trans*-10, *cis*-12 (28.9%), and *cis*-11, *trans*-13 (16.1%). All cows were pregnant; treatments began 200 d prepartum and continued for 140 d until dry off. This report presents preliminary data covering the first 8 wk of treatment. The greatest treatment effect was on milk fat. Cows receiving CLA had a lower milk fat test (2.82 vs. 3.72%; $P<0.001$) and a 20% reduction in milk fat yield (1048 vs. 1310 g/d; $P<0.001$). CLA supplemented cows had a trend for increased milk yield (36.9 vs. 35.2 kg/d; $P<0.09$) while milk protein yield was unchanged (1118 vs. 1088). The CLA group produced less 3.5% FCM (33.1 vs. 36.8 kg/d; $P<0.01$), but DMI was similar between groups (23.7 vs. 24.3 kg/d). Milk fatty acid analysis indicated CLA supplemented cows had a reduced content of short and medium chain fatty acids, whereas concentration of longer chain fatty acids was increased. Changes in specific fatty acids indicated that Δ^9-desaturase was reduced for the CLA treatment group. CLA fed animals also had an increased milk fat content of *cis*-9, *trans*-11 CLA (0.53 vs. 0.47%) and *trans*-10, *cis*-12 CLA (0.04 vs. <0.01%). Overall, feeding rumen-protected CLA resulted in a marked reduction in milk fat, a shift in milk fatty acid composition, a small increase in milk yield, and no change in milk protein.

Key Words: CLA, Milk Fat

502 Effect of pretrial milk yield on feed intake, digestion, and production responses to high- and low-fiber diets by dairy cows. J.A. Voelker*[1], G.M. Burato[2], and M.S. Allen[1], [1]*Michigan State University,* [2]*University of Padova, Italy*.

Effect of dietary concentration of NDF on DMI, DM digestibility, and milk yield was evaluated using 32 Holstein cows in a crossover design with two 16 d periods. Cows were 193 ± 55 (mean ± SD) DIM at the beginning of the experiment. Milk yield averaged 36.3 kg/d and ranged from 20.7 to 58.2 kg/d for the 14 d before initiation of treatments. Treatments were diets with forage to concentrate ratios of 67:33 and 44:56. Forages were alfalfa silage and corn silage, each at 50% of forage DM. Diets were formulated to 17.5% crude protein, and the NDF concentration of the high-NDF (H) and low-NDF (L) diets were 30.7% and 24.3% of DM, respectively. Greater digestibility of dietary DM was expected for L compared to H because grain is more digestible than forage. However, treatment did not affect DM digestibility, because digestibility of NDF and starch were greater ($P < 0.01$ for both) for H (33.2% and 89.7%, respectively) compared to L (26.9% and 86.0%, respectively). A greater increase in body condition score was observed for L compared to H ($P < 0.05$). No effects of treatment were observed for DMI, yield of milk or 3.5% fat-corrected milk (FCM), or percentage of milk components. However, individual DMI response to treatment (L-H) was positively correlated to pre-trial milk yield ($r = 0.43$, $P = 0.02$). DMI response (L-H) increased 0.127 kg/d per kg of pre-trial 3.5% FCM. Responses for yields of milk and fat-corrected milk to the low-fiber diet (L-H) showed a positive, quadratic relationship to pretrial milk yield ($P < 0.01$ for both). No relationship existed between milk composition response (L-H) and pretrial milk yield. The positive linear relationship observed between DMI response to the less filling, low NDF diet (L-H)

and pre-trial milk yield is consistent with the hypothesis that physical fill becomes a greater limitation on DMI as milk yield increases.

Key Words: Dietary NDF, Physical fill, Feed intake regulation

503 Dose-response effects of intra-ruminal infusion of propionate on feeding behavior of lactating dairy cows.

M. Oba* and M. Allen, *Michigan State University, East Lansing, MI.*

Dose-response effects of intra-ruminal infusion of propionate on feeding behavior of lactating dairy cows were evaluated. Eight ruminally cannulated Holstein cows (159 ± 26 DIM; mean ± SD) were used in a duplicated 4 x 4 Latin square design. Treatments were mixtures of sodium propionate and sodium acetate infused into the rumen continuously for 14 h at a rate of 25 mmol/min. Treatment solutions contained 0, 33, 67, or 100% sodium propionate (treatment A, B, C, or D, respectively) and sodium acetate was added to keep the osmolarity of infusates constant across the treatments. The experimental diet was formulated to contain 29% NDF, and dry cracked corn (mean particle size = 3.6 mm) was the major source of starch. Infusion started 2 h before feeding and ended 12 h after feeding. Feeding behavior was monitored for 12 h after feeding using a computerized data acquisition system. As infusion of propionate increased, dry matter intake decreased linearly ($P < 0.0001$; 15.0, 13.3, 11.5, and 8.3 kg/12 h, respectively for treatment A, B, C, and D), meal size decreased linearly ($P = 0.02$; 2.5, 2.0, 2.1, and 1.5 kg of DM, respectively for treatment A, B, C, and D), and inter-meal interval tended to increase linearly ($P = 0.08$; 75.4, 76.3, 87.7, and 90.1 min, respectively for treatment A, B, C, and D). Total energy intake was calculated by adding the energy of infusates to dietary energy intake. Total energy intake also decreased linearly ($P < 0.0001$; 30.0, 28.2, 25.9, and 21.5 Mcal NE_L/12h, respectively for treatment A, B, C, and D) as infusion of propionate increased. This indicates that the reduction in dietary energy intake due to propionate infusion was greater than the energy supplied from propionate infusions. Our results demonstrate that propionate plays an important role in feed intake regulation by affecting both satiety and hunger, and can explain depressed energy intake of lactating dairy cows consuming highly fermentable diets.

Key Words: propionate, feed intake regulation

504 Effects of intra-ruminal infusion of propionate salts on feeding behavior of lactating dairy cows.

M. Oba* and M. Allen, *Michigan State University, East Lansing, MI.*

Two experiments were conducted to evaluate effects of intra-ruminal infusion of propionate salts on feeding behavior of lactating dairy cows. Our working hypothesis is that hepatic metabolism of propionate causes satiety by increasing hepatic ATP concentration. We speculate that enhanced ATP concentration drives the Na/K pump, hyperpolarizes the hepatic vagus, decreasing its discharge rate, causing satiety. For both experiments, eight ruminally cannulated Holstein cows in mid-lactation were used in a duplicated 4 x 4 Latin square design, and intra-ruminal infusion started 2 h before feeding and ended 12 h after feeding. Treatments in the first experiment were mixtures of propionic acid and bicarbonate salt (none, ammonium, sodium, or potassium). Bicarbonate salts were infused at a rate of 11.9 mmol/min, and propionic acid was infused at a rate of 16.7 mmol/min for all treatments. We speculated that infusion of ammonium reduces the hypophagic effects of propionate because of utilization of ATP for urea synthesis and that infusion of sodium or potassium affects DMI by altering the discharge rate of the hepatic vagus. However, infusion of ammonium propionate tended to decrease DMI compared to sodium propionate and potassium propionate ($P < 0.08$; 11.2 vs. 13.6 and 13.7 kg/12 h), and DMI was not different between sodium propionate and potassium propionate infusions. In the second experiment, effects of VFA (propionate vs. acetate) and salt type (sodium vs. ammonium) on DMI were evaluated using a 2 x 2 factorial arrangement of treatments. The VFA salts were infused at a rate of 16.7 mmol/min. Ammonium treatment decreased DMI compared to sodium treatments ($P < 0.001$), and the effect of ammonium was significantly greater for cows infused with propionate (11.6 vs. 4.7 kg/12 h) compared to acetate (14.7 vs. 13.8 kg/12 h; interaction $P < 0.0001$). Contrary to our pre-trial hypothesis, ammonium has hypophagic effects, which might be because the urea cycle generates substrate for oxidation in the liver, increasing hepatic ATP concentration and decreasing DMI.

Key Words: feed intake regulation , propionate, ammonium

505 Characteristics of forages and TMR fed to dairy cows in Washington state dairy herds producing in excess of 12,730 kg of milk annually.

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The chemical composition of forages and TMR from seven Holstein dariy herds producing greater than 12,730 kg of milk annually were characterized to identify factors that contributed to high milk production. Forages and TMR for the high producing mature cow string in each herd were analyzed for CP, acid detergent insoluble CP (ADICP), starch, NDF, fat, Ca, P, Mg, K, and dietary cation-anion difference (DCAD). The concentration of CP and NDF in the TMR were above recommended ranges according to NRC (2001) for high producing mature cows in early lactation, except for NDF concentrations at Farm 1. The concentration of ADICP was under 2% indicating minimal bound protein in the diets. Calcium concentrations ranged from 23 to 78% greater and P concentrations ranged from 13 to 32% greater than NRC (2001) recommended levels for a sample diet that had similar animal and feed characterisitics to this study. Magnesium concentrations were 33 to 129% greater and K concentrations were 42 to 87% greater than NRC (2001) recommended levels for a sample diet. The DCAD concentration in the TMR was between 26 and 39 meq/100 g DM. These levels for DCAD in early lactation postpartum diets have been shown to maximize milk production in other studies. The corn silages ranged from 47 to 57% NDF and from 13 to 26% starch. The alfalfa hay samples ranged from 19 to 28% CP and from 38 to 46% NDF.

TMR Farm	CP %	ADICP %	Fat %	Starch %	NDF %	Ca %	P %	Mg %	K %	DCAD meq/100 g DM
1	18.5	1.7	6.0	17.9	30.6	1.07	0.50	0.45	1.71	27.6
2	17.8	2.0	7.0	17.1	34.5	1.00	0.49	0.41	1.65	33.3
3	18.7	1.7	6.1	21.4	35.6	0.97	0.47	0.40	1.53	29.2
4	18.5	1.2	6.4	23.8	35.4	0.94	0.44	0.48	1.69	30.8
5	21.6	1.7	4.7	18.2	35.0	0.94	0.50	0.45	2.00	39.3
6	17.8	1.9	5.1	25.0	34.3	0.74	0.47	0.28	1.52	34.4
7	19.7	1.5	5.0	18.5	33.6	0.98	0.43	0.51	1.58	26.4

Key Words: TMR, Forages, Chemical Composition

506 Nutrient intake and body characteristics of dairy cows in Washington state dairy herds producing in excess of 12,730 kg of milk annually.

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Seven Holstein dairy herds producing greater than 12,730 kg of milk annually were selected to characterize animal factors related to high milk production. Six herds used BST, one herd milked 2x, five herds milked 3x, and one herd milked 4x per day. In each herd the top mature cow string was measured for body characteristics and intake of nutrients. Other parameters that were measured included the number of cows in a string, DIM, milk production, and physical effectiveness of the diet (DM on two sieves of NASCO's® Particle Separator). Body weight was within 20 kg between herds, except for Farm 3, where the cows were giving more milk and weighed 50 to 70 kg less than the other herds in this study. The majority of the herds had DMI greater than 25 kg/day. Starch intake ranged from 4.1 to 6.8 kg/day, NDF intake ranged from 7.7 to 9.3 kg/day, and CP intake ranged from 4.6 to 5.3 kg/day. These results indicate that the level of starch and NDF in the diet can vary, and high levels of milk production can still be achieved. Physical effective fiber ranged from 44 to 76%, and physical effective NDF ranged from 15 to 27%. A minimum physical effective NDF intake of 20% of ration DM was recommended for lactating dairy cows.

Farm	No. Cows	DIM	Milk kg	Body Wt. kg	Wither Ht. cm	Length Wither to Pins cm	DMI kg	Physical Effect Fiber %	Physical Effect NDF, %
1	58	100	49.5	652	...	...	25.7	...	...
2	80	266	46.4	657	...	...	25.5	76.1	26.9
3	119	125	50.5	604	143	95	26.5	67.9	24.2
4	109	132	49.1	670	143	102	25.0	71.1	25.2
5	87	117	49.1	657	142	99	22.8	60.0	21.0
6	128	91	45.5	654	142	97	27.1	44.2	15.2
7	98	135	41.6	668	141	102	26.7	52.0	17.5

Key Words: Milk Production, Intake, Body Characteristics

ASAS/ADSA Teaching Undergraduate and Graduate Education and PSA Extension and Instruction: Teaching I

507 Poultry science student recruitment through teacher and counselor education. R.J. Lien, J.B. Hess*, R.A. Voitle, J.P. Blake, D.E. Conner, and W.D. Berry, *Auburn University, Auburn, AL 36849-5416*.

University poultry science student recruitment is vital to the long-term success of the poultry industry and the survival of university poultry science programs. Conservative estimates indicate that universities in the Southern U.S. are only able to fill 20-30% of the annual regional need for poultry science graduates in the poultry industry. Efforts by the U.S. Poultry and Egg Association and university poultry science programs are attempting to spread the message of job opportunities to potential high school and junior college students. Auburn University's Poultry Science Department instituted a Teacher/Counselor Education Program in 1995 in an attempt to reach more prospective students. Initial efforts were targeted at teachers and guidance counselors that had placed students with Poultry Science in the past. Subsequent efforts have drawn participants from state-wide mailings to all high school science and agribusiness teachers and counselors, and advertisements in counselor and science teacher association newsletters. Enrollment for the 1.5-day course (all expenses paid on campus) has averaged 20/year, with the majority of participants attending from schools in areas of poultry concentration. Continuing education credits are offered. Topics covered include Alabama and U.S. poultry industries, educational opportunities, departmental and college scholarships, job opportunities and veterinary school options. Average enrollments in the department have been 40% higher since the inception of this program.

Key Words: Student Recruitment, Undergraduate Teaching, Continuing Education

508 A paradigm to increase student enrollment in animal science courses and fulfill educational expectations. Darrel J. Kesler*[1], [1]*Department of Animal Sciences, University of Illinois*.

Projections that intensification of animal production is decreasing the need for animal scientists that could lead to the demise of the animal science profession (Cheeke, J. Anim. Sci. 77:2031; Letters to the Editor, J. Anim. Sci. 78:1691) have either generated concern, with little action, or are rejected. In an attempt to avoid the projection, I have developed and implemented a paradigm to increase student enrollment in animal science courses and the fulfill educational expectations of our new generation of animal science students. The first step was to reinvent an existing course, now titled Biology of Reproduction (AnSci/Biol 231). This involved changing a more traditional farm animal reproduction course to be more inclusive of all species, including humans (Kesler, NACTA J. 44[3]:11). The course was designed to fulfill general education requirements in natural sciences and was cross-listed in Biology. The second phase was the creation of a discovery course (AnSci 110), Life with Animals and Biotechnology, that approached the discipline in a non-traditional manner (Kesler, J. Anim. Sci. 75:273). It began as a 1-credit hour course but has been revised to a 3-credit hour course that fulfills general education requirements in natural sciences. The third phase involved instruction on nontraditional animal careers. Although this phase is incomplete, a traditional spring trip course was modified the past two spring semesters where students were introduced to biomedical industries with animal related careers. Student enrollment in AnSci 110 and 231 increased (r=.99; P<.01) from 66 in year 1 to 212 in year 7. Course quality evaluation ratings also increased (r=.94; P<.01) and paralleled (r=.95; P<.01) the increase in enrollment. Although the average class size (department enrollment 4 classes) also increased, course enrollment in AnSci 110 and 231 increased at a greater rate (3.5 times greater) increasing instructional units credited to animal science. The major reason for the increase was non-majors (41% of the students were non-majors this past year; r=.98 [P<.01]; non-majors were primarily from outside the college) enrolling in the course. Therefore, animal science can remain as a viable discipline; however, revision may be appropriate even if the pessimistic projection is wrong.

Key Words: Teaching, Course Enrollment, Undergraduate Education

509 A model for choosing instructional strategies to support distance education students. A.M. Shortridge and J.L. Emmert*, *University of Arkansas*.

The Department of Poultry Science at the University of Arkansas has developed web-based distance education courses in poultry science that include Broiler and Turkey Production and Breeder and Layer Management. Although the use of the Internet to teach university curricula is commonplace, few guidelines have been published to support course authors as they attempt to move their teaching out of the traditional classroom and into cyberspace. In an effort assure the quality of the courseware produced for this project we conducted an examination of current instructional design models, distance education and learning theories, the use of media in education, and available web-based distance education courses. The results indicated that most university level courses currently offered are limited in that they are not grounded upon an appropriate learning theory that is able to provide interactive instructional strategies. Results also indicated that the interactive component of web-based distance courseware could be increased substantially by the use of concept mapping within a human constructivist framework. Our next objective was to evaluate the integration of concept mapping into web-based distance education courseware as a tool to increase interactivity and learning outcomes. Students in traditional poultry production courses were provided with videotaped concept mapping instructions similar to what would be available on the Internet. Concept mapping assignments were then given before and after course modules were presented to allow comparison of pre- and post-maps. A blend of qualitative methods, including document analysis, observation, concept mapping and interviewing were used to probe a real-life context within a unique case orientation. This study also made use of data triangulation and investigator triangulation to establish credibility of the findings. Data indicate that concept mapping may be utilized successfully within web-based distance education courseware as a tool to enhance interactivity and establish effective pedagogy.

Key Words: Distance education, poultry production, concept mapping

510 Technology enhanced instruction: Incorporating Internet activities into a poultry products course. T. J. Buttles*[1] and B. S. Walters[2], [1]*University of Minnesota, St. Paul, MN*, [2]*University of Wisconsin - River Falls, River Falls, WI*.

The Internet is changing many aspects of our culture, including classroom instruction. Internet tools and resources have been added to the list of instructional methods available to teachers. Several different types of Internet based activities have been incorporated into the poultry products technology course offered as part of the Midwest Poultry