24.3 ±0.4 mo., and 24.3 and 23.6±0.3 mo., respectively). Compared to CR, dairy heifer growth in a beef system was set-back slightly after weaning and turnout, but this was overcome with time, and EP treatment increased serum prolactin and advanced predicted calving date.

Key Words: Puberty, Photoperiod, Dairy Heifers

Ruminant Nutrition: Nitrogen Metabolism – Dairy

484 Effects of duodenal infusion of graded amounts of threonine on lactational performances of dairy cows. H. Rulquin*[1] and P. M. Pisulewski[2], [1]*University and Research Unit on Milk Production*, *Saint Gilles, France*, [2]*Agricultural University*, *Cracow, Poland*.

Threonine is one of the proposed limiting amino acids for dairy cow. However, its requirement is poorly documented. A 4x4 Latin square was realized to study effects of duodenal infusion of graded amounts of Thr (0, 7, 28, and 49 g/d) during 4 days in 4 duodenaly canulated Holstein cows. DM of the diet consisted of 69 % corn silage, 4.9 % grass hay, 14% pea, 1.1 % molasses, 1.0 % urea, 7.3 % maize starch, 0.2 % fat, and 2.9 % of minerals and vitamins supplement. Diet covered 100 and 75% of energy and protein requirements. Requirements of the remaining 9 essential amino acids were met by infusing into the duodenum 666 g/d of a mixture including, Lys, His, Arg, Val, Met, Ile, Leu, Phe, Tyr, Trp and Glu (72, 33, 7, 41, 32, 27, 63, 19, 40, 4, 295 g/d respectively). Supply of Thr provided 75, 100, 125, and 150% of the expected requirements for the 4 treatments respectively. Concentration of Thr digestible in the small intestine were 3.65, 4.02, 5.0, 6.0 % of PDIE (equivalent to MP) for the 4 treatments respectively. Milk yield, fat yield and true protein content were not significantly affected by infusions. True protein yield tended to decrease linearly up to - 8 percent. It is concluded that Thr is not a limiting amino acid for dairy cows but excess of Thr decrease feed intake.

Table 1. Effects of Thr duodenal infusion on lactational performances

	Thr, g/d					
DMI, kg/d	20.1	19.4	19.6	18.1	0.34	L(P<0.01)
Milk, kg/d	30.0	28.8	27.5	28.9	0.58	NS
Fat yield, g/d	1442	1510	1389	1492	94	NS
True protein yield, g/d	886	851	853	812	22	L(P<0.1)
Fat content, %	4.78	5.17	5.09	5.17	0.34	NS
True protein content, %	2.96	2.96	3.12	2.82	0.06	NS
True protein content, %	2.96	2.96	3.12	2.82	0.06	NS

L = Linear effect; NS= non significant

Key Words: Thr requirements, Dairy cows, Milk protein

485 Effect of different forms of methionine on lactational performance of dairy cows. H. Rulquin*[1], B. Graulet[2], L. Delaby[1], and J. C. Robert[2], [1]*University and Research Unit on Milk Production*, *Saint Gilles, France*, [2]*Centre of Studies and Research on Nutrition*, *Commentry, France*.

The use of rumen-protected Met to correct diets of dairy cows is limited by the lack of an efficient product that could be incorporated into the concentrate. The main objective of this trial was to test at practical doses (around 10 g absorbable Met) the efficiency of two forms of pelletable Met hydroxy analogs, D,L-2-hydroxy-4-(methylthio)-butanoic acid (**HMB**) and the isopropyl ester of HMB (**HMBi**) to provide Met to cows, especially for milk protein synthesis compared to a control and to **SmartamineM**^{TM}. These treatments were tested according to a 4 x 4 Latin square in 16 Holstein cows. The mean DM composition of the diet was 71.6 % corn silage, 14.6 % energy concentrate, 3.1% soyabean meal, 7% formaldehyde-treated soyabean meal, 1 % urea, 1.3 % mineral and vitamin supplements, and 0.13 % of HMB or HMBi. Smartamine was supplied top dressed (17g/hd/day) Dry matter of the energy concentrate contained 21.8% ground barley, 21.1% ground wheat, 15% fine wheat bran, 37.5% dehydrated beet pulp, 1.7% beet molasses, 0.6% limestone, 1.1% sodium bicarbonate, and 1.1% salt. DMI, milk and fat yields were not affected by the treatments (20.5, 20.3, 20.7, 20.9 kg/d; 31.4, 31.8, 31.5, 32.0 kg/d, and 1291, 1337, 1300, 1312 g/d for control, HMB, HMBi, and Smartamine respectively). Milk true protein yield increased by 32 and 41 g/d and true protein content increased by 0.1 and 0. 07 % ($P < 0.05$) for HMBi and Smartamine respectively (962, 980, 994, 1003 g/d and 3.09, 3.10, 3.19, 3.16 % for control, HMB, HMBi and Smartamine respectively). Plasma Met concentrations were increased by 110 and 65 % that of the control value ($P < 0.05$) after HMBi and Smartamine treatments, respectively (16.49, 14.81, 34.65, 27.18 µM for control, HMB, HMBi and Smartamine respectively). Conversely to HMB, the isopropyl ester of HMB (HMBi) appeared to be an efficient source of methionine for dairy cows. As Smartamine, it significantly increases the milk protein yield and circulating Met level while HMB has no effect. HMBi is a new rumen-protected form of Met that can be supplied to cows integrated into pellets and this is important for feed manufacturer industry.

Key Words: Rumen-protected Met, Dairy cows, Milk protein

486 Effect of the isopropylester of the hydroxylated analogue of methionin (HMBi) on feed intake and performance of dairy cows in early lactation. V. A. Hindle[1], C. A. Kan[1], J. C. Robert[2], and A. M. van Vuuren*[1], [1]*Animal Sciences Group of Wageningen UR*, *Lelystad, The Netherlands*, [2]*Adisseo France SAS*, *Commentry, France*.

A performance trial involving 68 multiparous Holstein-Friesian dairy cows was carried out from parturition till 15 weeks post partum, to evaluate the efficacy of isopropylester of the hydroxylated analogue of methionin (HMBi). The cows were fed a TMR comprising grass silage, corn silage, grass straw and soybean meal and were randomly assigned to one of the two dietary treatments: concentrates containing HMBi (daily dose 29 g of HMBi per cow) or concentrates without HMBi; the latter designed to provide approximately 90% of methionin requirements. Cows entered the trial according to calving date. Feed intake, bodyweight and milk yield were recorded daily. Milk was sampled during three evening and three morning milkings weekly and analyzed for protein, fat and lactose. Statistical analyses were performed on the calculated weekly averages of week 3 to 15. In lactation weeks 3, 7, 11 and 15, extra milk samples were taken to determine MUN and true protein concentration, and blood samples were taken to determine urea. Data were obtained from 31 cows receiving HMBi and 34 cows receiving the control diet. Average

daily DMI was 25 kg without significant between-treatment variation. Average daily milk yield was 42 kg. No significant differences were observed between-treatment groups for yields of milk fat, milk protein and lactose. Milk fat concentration did not differ significantly between treatment groups. HMBi significantly increased milk protein concentration (3.28 % versus 3.17 % for Control; P = 0.002) and decreased lactose concentration (4.59 % versus 4.64 % for Control; P = 0.012). Milk true protein concentration was significantly higher in the HMBi group (2.98 % versus 2.89 % in the Control group; P = 0.03). Concentrations of MUN were always slightly lower for the HMBi group (11.2 mmol/L versus 11.9 mmol/L for the Control group; P = 0.04) which was in agreement with the difference in blood urea concentration. From these results, we conclude that HMBi increases true protein concentration in milk and improves nitrogen utilization in dairy cows fed diets with a limited methionin supply.

Key Words: Dairy cattle, Methionin, Milk protein

487 Effect of dietary crude protein, rumen-undegraded protein and rumen-protected methionine on milk production of lactating dairy cows. G. A. Broderick*[1], M. J. Stevenson[2], and R. A. Patton[3], [1]*U.S. Dairy Forage Research Center*, *Madison, WI*, [2]*Degussa Corp.*, *Kennesaw, GA*, [3]*Nittany Dairy Nutrition, Inc.*, *Mifflinburg, PA*.

When crude protein (CP) is fed above that needed to meet requirements for metabolizable AA, excess urinary N contributes to environmental pollution. Rumen-undegraded protein (RUP) or rumen-protected Met (RPMet) may permit reduction of dietary CP without loss of production. A lactation trial was conducted using diets formulated to contain 28% NDF and 16.8 or 15.5% CP [dry matter (DM) basis], with or without RUP added as expeller soybean meal (ESBM). Diets were fed as TMR and contained (DM basis) 20% alfalfa silage, 35% corn silage, 4% soyhulls, 2% ground shelled corn, 2% rumen-inert fat, 0.5% sodium bicarbonate and 0.5% vitamins and minerals. Diets with 16.8% CP contained about 23% high moisture corn and 13% soybean meal; diets with 15.5% CP contained about 26% high moisture corn and 10% soybean meal. The RPMet was fed as Mepron®. Forty-eight Holstein cows were blocked by DIM into 6 groups of 8, randomly assigned to incomplete 8x8 Latin squares and fed the TMR for three 4-wk periods. Data were summarized from the last 2-wk of each period. The statistical model included square, period, cow(square), diet, and diet*period. Probability was set at 0.05; LS means are reported below. Contrasts indicated that higher dietary CP increased intake and yield of milk, FCM, fat and protein but RUP reduced fat and protein yield. Feeding RPMet increased intake and yield of FCM, fat and protein. Feeding RUP increased milk/DM intake. Milk urea was increased by both CP and RUP. While supplementing RPMet at 15.5% CP gave production comparable to 16.8% CP without RPMet, RPMet gave similar responses at both CP levels.

Table 1.

CP, %	15.5	16.8	P > F						
ESBM, %				0.0	5.0	P > F			
Mepron, g/d							0	15	P > F
Variable									
DM intake, kg/d	24.3	25.4	<0.01	25.1	24.7	0.13	24.6	25.2	0.04
BW gain, kg/d	0.37	0.38	0.96	0.42	0.33	0.50	0.35	0.40	0.67
Milk, kg/d	40.0	41.6	0.01	40.8	40.9	0.88	40.5	41.2	0.26
Milk/DMI	1.65	1.64	0.62	1.63	1.67	0.03	1.65	1.64	0.60
3.5% FCM, kg/d	44.9	47.2	0.01	45.4	46.6	0.16	45.1	46.9	0.04
Fat, kg/d	1.43	1.52	0.01	1.44	1.51	0.07	1.44	1.51	0.02
Protein, kg/d	1.28	1.32	0.04	1.31	1.29	0.24	1.28	1.32	0.05
Lactose, kg/d	1.93	1.99	0.10	1.96	1.96	0.98	1.94	1.98	0.25
SNF, kg/d	3.58	3.68	0.07	3.64	3.62	0.72	3.59	3.67	0.17
MUN, mg/dl	9.8	11.5	<0.01	10.4	11.0	<0.01	10.6	10.8	0.36

Key Words: Dietary crude protein, Rumen-undegraded protein, Rumen-protected methionine

488 Milk production response of dairy cows to silage mixtures fed with concentrates of varying ruminal degradation rate. A. Konyali[1,2], K.-H. Südekum*[1,3], W. Junge[1], and E. Kalm[1], [1]*University of Kiel*, *Kiel, Germany*, [2]*Çanakkale Onsekiz Mart University*, *Çanakkale, Turkey*, [3]*University of Bonn*, *Bonn, Germany*.

The objectives of this study were to evaluate effects on lactational performance and efficiency of nitrogen utilization of dairy cows fed with isocaloric and isonitrogenous concentrates that also had similar ruminal degradabilities of crude protein (CP) and organic matter (OM) but differed in the rate CP and OM were degraded ruminally. Both concentrates were supplemented to mixtures (80:20 and 20:80, dry matter basis; CORN and GRASS, respectively) of corn and grass silage so that ruminal degradation rate was synchronous either to the GRASS (SYNGRASS) or the CORN (SYNCORN) silage mixture and asynchronous to the other. During two complete winter feeding periods, 252 dairy cows, 120 (62 Red Pied and 58 German Friesian) in year 1, and 132 (65 Red Pied and 67 German Friesian) in year 2, were fed on diets consisting of combinations of one of the concentrates that were allocated according to milk yield and one of the silage mixtures fed for ad libitum intake. Neither forage nor concentrate type affected ($P > 0.05$) milk (26.5 kg/d) or milk component yields (fat, 1.18 kg/d; total protein, 0.92 kg/d), though milk protein concentration was higher ($P < 0.05$) for cows on the CORN treatments. Feeding the GRASS mixture resulted in elevated ($P < 0.001$) milk urea levels, which were also higher for cows on the SYNCORN than on the SYNGRASS treatments (interaction effect; $P < 0.001$). Efficiency of N utilization was higher ($P < 0.001$) for cows on the CORN (27%) than on the GRASS (24%) treatments but was not affected ($P > 0.05$) by concentrate type.

Key Words: Protein, Carbohydrate, Rumen synchrony

489 Reduced rumen degradable protein (RDP) and abomasal inulin reduce diet digestibility and urinary nitrogen in lactating dairy cows. T. F. Gressley* and L. E. Armentano, *University of Wisconsin*, *Madison*.

Increasing intestinal carbohydrate fermentation in dairy cows may increase conversion of blood urea N (BUN) into fecal microbial protein. This should reduce urinary N and consequently reduce manure ammonia volatilization. However, if BUN recycling to the intestine competes with BUN recycling to the rumen, hindgut fermentation may reduce ammonia available for rumen microbial metabolism. Eight lactating Holstein cows were used in a replicated 4x4 Latin square design with 14-day periods. Treatments were arranged as a 2x2 factorial. Cows were fed diets predicted (NRC, 2001) to contain adequate RDP (HP) or RDP 28% below requirements (LP). Cows also received abomasal infusions via a rumen fistula of 10 L/d saline alone (S) or 10 L/d saline plus 1 kg/d inulin (I). Reducing RDP did not reduce urinary purine derivative excretion or milk production but reduced rumen *in situ* neutral detergent fiber (NDF) digestion. Abomasal inulin did not reduce ruminal ammonia or *in situ* NDF digestibility, suggesting that hindgut fermentation of inulin did not compete for ruminal ammonia. Inulin shifted 23 g/d N from urine to feces, however we estimated that only 8 g/d of the increase in fecal N was due to increased fecal microbial output. Although increasing hindgut fermentation in practical diets may reduce manure ammonia volatilization, it may also interfere with intestinal digestibility. Alternatively, reduced digestibility may have been an artifact of the model.

Table 1.

	Treatment				*P value*		
	LPS	LPI	HPS	HPI	RDP	I	RDP x I
Milk, kg/d	29.7	31.3	30.4	29.3	0.25	0.63	0.02
Oral DMI, kg/d	20.0	20.3	20.2	19.8	0.53	0.88	0.25
OM digestibility including inulin, %	64.1	62.8	67.5	64.6	0.05	0.10	0.50
Starch digestibility, %	94.3	92.0	95.8	94.3	0.008	0.01	0.53
In situ NDF digestibility, %	24.6	25.3	27.6	27.3	0.02	0.85	0.57
Urine N, g/d	140.5	124.2	245.8	213.4	0.001	0.02	0.36
Feces N, g/d	149.3	166.9	143.1	172.4	0.95	0.001	0.30
BUN, mg/dl	6.6	5.7	13.1	12.2	0.001	0.05	0.98
Rumen NH_3, mM geometric mean	1.68	1.27	3.42	3.95	0.001	0.43	0.03
Urine allantoin+uric acid, mmol/d	450	487	501	481	0.11	0.56	0.05
Fecal purines, g/d	10.28	10.69	9.07	11.41	0.40	0.001	0.005

Key Words: Fructans, Fecal nitrogen, Urinary nitrogen

490 Evaluation of dried distillers grains versus soybean protein as a source of rumen-undegraded protein for lactating dairy cows. B. W. Pamp*, K. F. Kalscheur, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University*, *Brookings*.

Ten primiparous and ten multiparous Holstein dairy cows (127 ± 29 DIM) were used in a 5 × 5 Latin square design with 28 d periods to evaluate the effect of increasing rumen-undegraded protein (RUP) by comparing dried corn distillers grains with solubles (DDGS) vs. soybean protein (SBM 44%, extruded beans, soy hulls, and Soyplus®) as a protein source in lactation diets. Diets were formulated to provide 3 concentrations of dietary RUP (% of DM) from 2 different sources: 1) 5.3% RUP (control), 2) 6.8% RUP from soybean protein, 3) 6.8% RUP from DDGS, 4) 8.3% RUP from soybean protein, and 5) 8.3% RUP from DDGS. All diets were formulated to contain 10% RDP. Diets consisted of 38.5% corn silage, 16.5% alfalfa hay, and 45% concentrate (DM basis). Dry matter intake tended to increase with the addition of RUP ($P < 0.09$). Milk production (31.1, 32.3, 34.2, 33.7, and 34.8 kg/d for diets 1 through 5, respectively) increased ($P < 0.05$) with the addition of RUP, and was greater for cows fed diets containing DDGS vs. soybean protein. Percentage of milk fat was not affected by treatment, however, milk fat yield (1.11, 1.12, 1.22, 1.16, and 1.22 kg/d) was greater for diets containing DDGS compared to soybeans ($P < 0.05$). Milk protein concentration (2.82, 2.80, 2.84, 2.81, and 2.86%) was greatest for diets containing DDGS ($P < 0.01$). Milk protein yield (0.87, 0.90, 0.97, 0.94, and 0.99 kg/d) was greater for diets containing DDGS ($P < 0.01$) and increased with the addition of RUP ($P < 0.01$). The greatest increase in lactose yield (1.50, 1.58, 1.65, 1.63, and 1.68 kg/d) occurred with DDGS supplementation ($P < 0.05$). Increasing dietary RUP increased MUN (12.8, 15.0, 15.3, 18.1, and 17.7 mg/dl; $P < 0.01$). The greatest increase in energy-corrected milk occurred with the addition of DDGS ($P < 0.05$). Multiparous cows fed diet 5 improved in feed efficiency compared to primiparous cows resulting in a treatment × parity interaction ($P < 0.03$). Increasing RUP in the form of DDGS increased milk production and milk component yields to a greater extent than RUP supplied by soybean protein.

Key Words: Dried distillers grains, Soybean protein, Rumen-undegraded protein