

Student Research Abstracts



Determination of Isopropyl-2-Hydroxy-4(methylthio)-Butanoic Acid Degradation and Mechanism of Stimulation of Bacterial Populations and Efficiency of Protein Synthesis in Continuous Culture

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The primary source of protein for milk production is of microbial origin, so increasing microbial protein supply should either increase milk protein or decrease the need for expensive bypass protein. Moreover, improving the consistency of prediction of microbial protein supply decreases the amount of protein that must be fed to the dairy cow, reducing urinary N excretion and decreasing feed costs. Methionine is co-limiting with lysine in most dairy diets. Isopropyl-2-hydroxy-4-(methylthio)-butanoic acid (**HMBi**) is a methionine precursor for bacteria and may be degraded more slowly, and therefore, retained in the rumen longer than methionine itself. The HMBi can increase milk protein production per unit of protein intake. To show the effect of HMBi and methionine on bacterial population structure and protein synthesis and to ascertain the kinetics of HMBi degradation and methionine metabolism, we used four continuous culture fermenters inoculated with rumen fluid from two lactating Holstein cows. We fed the 4 cultures a 50/50 ratio of concentrate and alfalfa for 4 periods in a 4x4 Latin square. Treatments were control (**CON**), 0.11% HMBi (HMBi), 0.097% methionine (**MET**), and 0.055% HMBi plus 0.048% MET (HMBi + MET). All doses were on an equivalent MET basis. We dosed the stable isotopes 1-¹³C-methionine, ³D-methionine (methyl hydrogens labeled with deuterium), and U-¹³C-HMBi into the fermenters at six consecutive feedings to follow the incorporation of the carbon skeletons into microbial protein and methylation of substrates by methionine. We fed the fermenters thrice per day, with the treatments and isotopic doses added as liquid directly to the fermenter contents (the control received an equivalent amount of water). Our preliminary results show trends for an increase in acetate:propionate ($P < 0.077$), increase in peptide-N ($P < 0.06$), and a decrease in NH₃-N ($P < 0.10$) with HMBi.

Preliminary Data

Parameter	Treatments				SE	P-value
	HMBi	HMBi+MET	MET	CON		
Effluent peptide-N, mg N/dL	6.14 ^a	5.14 ^b	5.29 ^b	5.17 ^b	0.27	< 0.06
Effluent NH ₃ -N, mg N/dL	5.65 ^b	7.21 ^a	6.80 ^a	6.22 ^{ab}	0.37	< 0.10
Propionate, %	18.6 ^{bc}	18.3 ^c	19.7 ^a	19.6 ^{ab}	0.41	0.07
Isovalerate, %	2.74 ^a	2.74 ^a	1.83 ^b	1.84 ^b	0.39	< 0.09
Valerate, %	2.85 ^a	2.73 ^{ab}	2.17 ^b	2.22 ^b	0.07	0.01
BCVFA ¹ , %	3.04 ^a	3.11 ^a	2.18 ^b	2.14 ^b	0.29	< 0.10
Acetate:Propionate	3.49 ^{ab}	3.58 ^a	3.28 ^b	3.33 ^b	0.09	< 0.08

¹Branched-chain volatile fatty acids (isovalerate and butyrate) as a percentage of total VFA.

^{abc}Means in the same row with different superscripts differ.

Dietary Coconut Oil and Animal Fat Blend Decrease Lactational Performance of Holstein Cows Fed a High Starch Diet

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Medium-chain fatty acids in coconut oil (**CO**) are known to suppress methane generation in the rumen. However, little is known about the impact of CO on lactational performance. Our objectives were to evaluate the supplementation of dietary lipids in a high-starch diet fed to mid-lactation Holstein cows and to compare the incremental replacement of an animal fat blend (**AFB**) with CO. Thirty-two multiparous cows were adapted for 4 weeks to a basal diet (**CONTROL**) with 60% concentrate: 28% corn silage: 12% alfalfa silage and hay, dry basis. CONTROL was formulated to contain: 16.5% CP (10.1% RDP and 6.4% RUP), 27.4% NDF (67% of NDF from forage), 3.0% fat, and 36.8% starch, dry basis. During the last week of adaptation, covariates of performance were measured daily. Cows were blocked by covariate milk yield (**MY**) and assigned to one of four iso-nitrogenous diets (n = 8 per treatment): CONTROL; 5% AFB; 2.5% AFB; 2.5% CO; or, 5% CO, dry basis. When fat was substituted for dry ground corn, corn gluten meal was added to maintain protein quantity and profile of all diets. Measurements of cow performance and milk composition monitored during week 3 of feeding treatment diets are presented in the table. However, DMI and MY dropped 39% and 24%, respectively, within 3 days with 5% CO, and those cows were removed from the trial on d 6; their data were excluded from statistical analysis. Fat supplementation reduced DMI, MY, and milk component yields and depressed milk fat and lactose concentrations. Milk fat concentration, but not intake of C18:2, correlated negatively to concentration of C18:2c9 t11 in milk fat. Partially replacing AFB with CO additionally lowered milk fat concentration and yield but increased concentration of medium-chain fatty acids in milk fat. The loss of production with feeding CO may hinder its suitability to reduce methane emission, while sustaining national milk production.

	Diets			SE	Contrasts (<i>P</i> <)	
	Control	AFB	AFB-CO		Control vs. AFB, AFB-CO	AFB vs. AFB-CO
DMI, lb/day	59.7	53.3	50.0	1.78	0.01	0.19
MY, lb/day	94.2	85.9	81.0	4.84	0.02	NS ¹
ECM yield, lb/day	87.2	72.9	67.6	3.85	0.01	NS
Milk fat, %	3.06	2.59	2.11	0.133	0.01	0.02
Milk fat, lb/day	2.86	2.33	1.63	0.251	0.01	0.02
Milk protein, %	3.03	3.12	3.05	0.046	NS	NS
Milk protein, lb/day	2.86	2.64	2.42	0.102	0.02	0.12
Milk lactose, %	4.95	4.80	4.76	0.094	0.02	NS
Milk lactose, lb/day	4.71	4.05	3.88	0.209	0.01	NS
C18:2c9 t11, g/100 g fat	0.04	0.07	0.12	0.018	0.03	0.07
Sum C10 – C15, g/100 g fat	22.46	15.68	23.16	0.862	0.01	0.01

¹NS = Non-significant.

Lactation Performance of Ewes Fed Diets with Different Rumen Degradable Protein Concentrations

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Efficient dietary nitrogen utilization is very important due to economic and environmental impacts. Forty-eight Santa Inês lactating ewes (128 ± 11 lb of initial BW) were penned individually and assigned to a complete randomized block design with 12 blocks and 4 treatments to determine the effects of diets containing N sources with different ruminal degradability on dry matter intake (**DMI**), milk yield, and milk composition. Ewes were fed a 70:30 (concentrate: roughage ratio) TMR, formulated to provide similar concentrations of CP (16%) and different concentrations of ruminal undegradable protein (**RUP**). Soybean meal (**SBM**), corn gluten meal (**CGM**), corn gluten meal plus urea (**CGM+U**), and urea (**U**) were used as N sources, resulting in diets with 39.4, 35.3, 25.5, and 18.0% of CP as RUP, respectively. Ewes were milked weekly (from the 2nd to the 8th week after parturition), using the 3-h production estimates. The DMI (4.82, 4.00, 3.67 and 3.81 lb/day) was higher for the SBM diet. However, milk production (2.62, 2.42, 2.31, and 2.33 lb/day⁻¹) and 6.5% fat-corrected milk (4.80, 5.94, 5.41, and 4.16 lb/day⁻¹) was similar ($P > 0.05$) among diets. Milk fat content (7.8, 8.6, 8.2, and 8.0%) was lower for SBM when compared to CGM. Milk protein content (4.7, 4.7, 4.6 and 4.6%) was similar among treatments. However, protein production (55.7, 50.2, 47.1 and 46.7 g/day) was higher for SBM and CGM compared to CGF+U and U diets. Similar results were observed for milk urea nitrogen content (18.1, 18.0, 16.4 and 17.2 mg/dl) and milk urea nitrogen production (234.6, 196.7, 170.6 and 176.01 g/day⁻¹). Ewes fed high amounts of rumen degradable protein had higher weight loss and decreased body condition score. Although they reduced DMI, corn gluten meal, dry corn gluten feed, and urea can be used as N sources in diets for lactating ewes with no detrimental effects on milk yield and composition.

Use of Ash and Nitrogen Concentrations in Manure to Estimate Loss of Ammonia Over Time

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The aim of this study was to validate a mass balance method based on N and ash in manure to estimate NH_3 losses from manure. Six multiparous Holstein cows were used in a replicated 3 x 3 Latin square with three 14-day periods. Two diets were balanced to contain 15.5% CP, but in one, the forage (58% of dietary DM) was mainly corn silage (CS), and alfalfa silage was the primary forage in the other (AS). A third diet (CSU) was the same as the CS diet except that 0.5% of urea was added (17.3% CP). During total collection digestion trials (last 4 days of each period), urine and feces samples were used to prepare a slurry mixture (1200 g) in the same proportion as excreted by each cow. Slurries were sampled immediately after mixing, incubated at ambient temperature (12°C) for 3 days and sampled again. Initial and final N concentrations and slurry masses were used to determine N losses. Nitrogen loss was estimated using the mass balance method as: $(\text{N Intake} - \text{N Milk}) - \text{N/Ash} * (\text{Ash Intake} - \text{Ash Milk})$, where N and Ash Intakes and N and Ash Milk are g/day and N and ash concentrations in slurry samples at 3 days (49.3 and constitute the N/Ash ratio. Average DM intake and milk yield were 22.4 and 32.0 kg/day (49.3 and 70.4 lb/day), respectively, and were not affected by treatment. Average manure output was 65.4 kg/day (143.9 lb/day) with cows fed AS and CSU excreting an average of 18.6 kg/day (40.9 lb/day) of urine followed by CS at 14.5 kg/day (31.9 lb/day) ($P = 0.02$). Manure N excretion was highest for cows fed CSU, followed by AS and CS (422, 392 and 343 g/day, $P < 0.01$). Urinary N as percent of excreted N was 34, 41, and 53 % for AS, CS, CSU, respectively ($P < 0.01$). Ash excretion in manure was highest for cows fed AS (1134 g/day); and CS and CSU had similar ash excretion (936 g/day) ($P < 0.01$). Urine contributed 46, 42, and 40% of excreted ash for AS, CSU and CS, respectively. Measured NH_3 -N loss was 30, 41, and 70 g/3 days for AS, CS and CSU and calculated losses were 17, 31, and 75 g/3 days, respectively (AS=CS<CSU for both measured and calculated losses, $P = < 0.01$). Average estimated NH_3 -N losses did not differ from measured losses ($P = 0.15$), but calculated values averaged 6 g less. The method underestimated NH_3 -N losses in cows with negative N balance and overestimated it for cows in positive N balance.

Feeding Value of Wet Distillers Grains for Lactating Dairy Cows When Co-ensiled with Corn Silage or Haycrop Silage

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Rapid spoiling is inherently associated with wet distillers grains with solubles (**WDGS**). Herd size and storage facilities may limit the use of WDGS by dairy producers. The objectives of this study were to evaluate the nutritional value of WDGS when co-ensiled with either whole plant chopped corn or with chopped grass forage as a method to reduce WDGS storage losses. Sixteen mid-lactation Holstein cows were used in two separate feeding experiments. Both studies were conducted as 21 days, 3-period switchback designs. Cows were fed either a diet where individual feeds were combined at the time of feeding or WDGS was co-ensiled with corn silage (**WDGSCS**) and fed as a diet ingredient or co-ensiled with direct cut haycrop forage (**WDGSHS**) and fed as a diet ingredient. The controls for WDGSCS and WDGSHS contained the same plant materials used to create the co-ensiled feeds. In both studies, WDGS were at 15% of the ration DM. Cows were 1340 ± 4 lb with 2.64 ± 0.02 BCS and averaged 81.1 ± 0.8 lb/day of milk at the beginning of the experiments. Milk production, milk composition, and feed intake did not differ ($P > 0.05$) for cows fed WDGSCS compared to the corn silage control diet. Cows fed WDGSHS ate 4.4 lb/day more DM ($P < 0.05$) and produced 3.5 lb/day more milk ($P < 0.05$) than cows fed the same forage ensiled alone and fed as part of the ration. These data indicate the feeding value of corn silage is not negatively affected when co-ensiled with WDGS. The feeding value of direct cut haycrop forage is enhanced when co-ensiled with WDGS. These data demonstrate the potential to remove limitations for using WDGS on small and medium sized farms through co-ensiling with either corn- or grass-forage.

Intake and Growth of Dairy Heifers Fed Deoiled Dried Distillers Grains

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With the recent growth in the ethanol industry, there are greater opportunities to utilize coproduct feeds in the rearing of dairy heifers. Distillers grains that are processed for reduced oil content may provide some advantages in heifer rations. Our objective was to evaluate intake and growth of heifers fed diets containing deoiled dried distillers grains. Thirty-six Holstein heifers, averaging 347 lb and 161 days of age at the start of the study, were blocked by body weight and randomly assigned to either: control diet containing soybean meal and no distillers grains (**CON**), dried distillers grains fed at 20% of the diet DM (**DDGS**), deoiled dried distillers grains at 20% of the diet DM (**dDGS1**), or deoiled dried distillers grains at 36% of the diet DM (**dDGS2**). Heifers were housed individually and fed once daily for free choice intake. Diets were balanced to have equal energy concentrations and were fed for 12 weeks. The heifers were weighed biweekly to determine average daily gains (**ADG**). At the beginning, middle, and end of the study, measurements were taken for hip height and wither height, and blood samples were taken to determine plasma urea nitrogen (**PUN**). Body condition was scored at the beginning and end of the study. There were no significant differences in dry matter intakes (**DMI**) among the diets. Overall, ADG was not affected ($P > 0.20$) by the type or inclusion rate of distillers grains (2.51, 2.42, 2.57, and 2.49 lb/day for CON, DDGS, dDGS1, and dDGS2, respectively). Feed efficiency was not different ($P > 0.30$) among treatments and averaged 5.73 lb DMI/lb of gain. Body condition scores were similar across treatments and averaged 3.00 at the beginning of the study and 3.14 at the end of the study. No differences were found among treatments for wither heights, hip heights, or PUN. Inclusion of deoiled distillers grains at 20 or 36% of the diet appears to be a viable option for the rearing of replacement heifers.