

Effect of supplemental rumen undegradable protein and glucogenic precursors on digestibility and energy metabolism in sheep

Tasha King, Joslyn Beard, Mitch Norman, Hannah Wilson, Jim MacDonald, and Travis Mulliniks

Objective: To determine the effect of supplemental glucogenic potential (GP) on forage digestibility, serum metabolites, and energy utilization of a forage diet.

Treatments: Supplements were designed to supplement increasing amount of GP: (1) no supplementation (CON; 0 g), (2) 40 g of calcium propionate (CAP; 30 g of GP), (3) 70 g of blood meal + 100 g of feather meal (BF; 40 g of GP), or (4) combination of CAP and BF (COMBO; 70 g of GP). Four periods were utilized to allow each lamb to receive each treatment once.

Results: Wethers on BF and COMBO supplementation had greatest DM and OM total tract digestibility ($P \leq 0.01$). Supplementation did not affect ($P = 0.93$) NDF digestibility. Serum glucose concentrations were not affected ($P = 0.98$) by supplementation. However, SUN concentrations were increased ($P < 0.01$) for BF and COMBO compared to CAP and CON. Acetate half-life did not differ ($P = 0.39$) due to supplementation. Area under the curve (AUC) for acetate was affected ($P = 0.04$) by supplemental treatments. No supplementation had a greater ($P \leq 0.04$) acetate AUC than BF and COMBO and tended ($P = 0.08$) to be greater than wethers receiving CAP. Glucose AUC were not affected ($P = 0.80$) by supplementation. These results suggest that RUP supplementation will improve digestibility and nutrient utilization in wethers consuming forage-based diets. Supplementation of a glucogenic precursor in the form of a propionate salt without additional RUP supplement had no effect on forage digestibility and a tended to have a decreased acetate AUC. These results suggest that for an improvement in energy efficiency protein requirements must be met.

Further Analysis: Completion of analysis will look at digestible energy, ruminal ammonia and VFA concentrations, insulin and amino acid concentrations, and overall glucogenic enzyme concentration in the liver.

Table 1. Total tract digestibilities for wethers supplemented with glucogenic precursors fed a forage-based diet.

	Supplementation Treatment				SEM	P-value
	CON ¹	CAP ²	BF ³	COMBO ⁴		
DM						
Total intake ⁵ , kg	5.17 ^d	5.26 ^c	5.82 ^b	6.07 ^a	0.11	< 0.01
Digestibility, %	37.4 ^b	36.6 ^b	43.0 ^a	42.9 ^a	0.98	< 0.01
OM						
Total intake, kg	4.73 ^d	4.84 ^c	5.55 ^b	5.66 ^a	0.10	< 0.01
Digestibility, %	42.6 ^b	43.6 ^b	49.8 ^a	49.8 ^a	1.11	< 0.01
NDFD_{om}⁶						
Total intake, kg	3.50	3.50	3.49	3.49	0.08	0.98
Digestibility, %	44.8	45.2	45.8	45.3	1.28	0.93
ADF						
Total intake, kg	2.32 ^b	2.31 ^b	2.47 ^a	2.48 ^a	0.07	< 0.01
Digestibility, %	35.6 ^{bc}	35.4 ^c	39.2 ^a	38.5 ^{ab}	1.31	0.03

^{a-d}Means within a row with different superscripts differ ($P < 0.05$).

¹CON: No supplementation.

²CAP: Supplementation of 40 g of NutroCal (Kemin Industries Inc., Des Moines, IA).

³BF: Supplementation of 70 g of blood meal + 100 g of feather meal.

⁴COMBO: Supplementation of 40 g of calcium propionate + 70 g of blood meal + 100 g of feather meal.

⁵Total intake = basal diet + supplementation.

⁶NDF_{om} = ash-free NDF.

Table 2. Effect of supplement on acetate tolerance test for wethers consuming a forage- based diet supplemented with glucogenic precursors.

Acetate tolerance test response	Supplementation Treatment				SEM	P-value
	CON ¹	CAP ²	BF ³	COMBO ⁴		
Acetate half-life, min	39	33	26	31	6	0.39
Acetate AUC ⁵	298 ^a	242 ^{ab}	205 ^b	228 ^b	24.3	0.04
Glucose AUC	310	310	326	316	15.7	0.80

^{a,b}Means with differing superscripts are different ($P < 0.05$).

¹CON: No supplementation.

²CAP: Supplementation of 40 g of NutroCal (Kemin Industries Inc., Des Moines, IA).

³BF: Supplementation of 70 g of blood meal + 100 g of feather meal.

⁴COMBO: Supplementation of 40 g of calcium propionate + 70 g of blood meal + 100 g of feather meal.

⁵AUC: area under curve

Table 3. Impact of glucogenic precursor supplementation on serum metabolites of wethers fed a forage-based diet.

Measurements	Supplementation Treatment				SEM	<i>P</i> -values		
	CON ¹	CAP ²	BF ³	COMBO ⁴		Trt	Time	Trt x Time
Jugular Glucose mg/dL	55.4	54.1	55.8	55.8	1.93	0.87	< 0.01	0.57
Saphenous Glucose mg/dL	56.7	54.8	55.5	58.0	1.84	0.47	< 0.01	0.16
Jugular SUN ⁵ , mg/dL	11.3 ^b	10.6 ^b	25.9 ^a	25.5 ^a	1.12	< 0.01	< 0.01	0.23
Saphenous SUN, mg, dL	11.6 ^b	11.2 ^b	25.7 ^a	25.2 ^a	1.09	< 0.01	< 0.01	0.13

^{a,b}Means with differing superscripts are different ($P < 0.05$).

¹CON: No supplementation.

²CAP: Supplementation of 40 g of NutroCal (Kemin Industries Inc., Des Moines, IA).

³BF: Supplementation of 70 g of blood meal + 100 g of feather meal.

⁴COMBO: Supplementation of 40 g of calcium propionate + 70 g of blood meal + 100 g of feather meal.

⁵SUN = serum urea N.