SILAGE FOR BEEF CATTLE
2018 CONFERENCE

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SILAGE GROWING PROGRAMS AND IMPORTANCE OF PROTEIN (RUP)

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A tremendous benefit of cattle is their ability to convert a wide range of feedstuffs into edible products for humans. This is very evident in the growing or backgrounding component of the industry where it seems variation and creativity are the norm. With this wide range in feedstuffs, formulating diets to meet nutrient requirements becomes very important, especially for young, growing cattle that have high protein requirements.

Most growing diets are forage based. While forages can have fairly high CP levels, the majority is rumen degradable protein (RDP). The RDP is fermented in the rumen and utilized by the microbes for growth. The growing calf also requires metabolizable protein (MP) which is composed of rumen undegradable protein (RUP; feed protein that escapes degradation in the rumen) and microbial crude protein (MCP; microbes that pass out of the rumen and are a fairly high quality protein source for the animal). Growing diets based on corn silage largely depend on MCP as the source of amino acids for the animal as the RUP content of corn silage is very low.

Accurately measuring the RUP content of corn silage has been challenging. Lab techniques designed to measure RUP values of feedstuffs are specific to either forages or concentrates, and corn silage is a blend of both. The DM content of the corn silage impacts the degradability of the protein (wetter corn silage has a lower RUP content) and the protein continually becomes more degradable with longer ensiling times. Thus, RUP content of corn silage is a moving target. Two experiments using duodenally fistulated steers and in situ bags measured the RUP content of corn silage by breaking the silage down into forage and grain. Results suggest the RUP content of corn silage is 10% of the CP, meaning that the CP within corn silage is 90% rumen degradable (Oney et al., 2018).

Corn silage growing diets are therefore deficient in MP for growing calves. This is clearly demonstrated by a series of trials (Table 1). Folmer et al. (2001) fed a 90% corn silage diet to 619 lb growing steers. The remaining 10% of the diet was composed of soybean meal (6.5%), urea (0.85%), dry-rolled sorghum (1.2%), vitamins and minerals. The soybean meal and urea are both excellent sources of protein, but soybean meal is approximately 70% RDP and urea is 100% RDP. The CP of the diet was 12.4% and cattle gained 2.95 lb/d with a F:G of 6.33. Weber et al. (2011) had a very similar trial with an 80% corn silage diet fed to 613 lb growing steers. Supplement in this trial was 15% distillers grains (DGS), fine ground sorghum (3%), vitamins and minerals. The DGS contain 30% CP and this CP is 63% RUP. The CP of the diet was 13.0% and cattle gained 3.61 lb/d with a F:G of 5.75. Felix et al. (2014) fed a 79% corn silage growing diet to 590 lb growing steers. Three treatments were evaluated, cattle supplemented 1.43% urea, 9.2% soybean meal with 9.6% ground corn, or 18% DGS. The CP of all diets was 10.7% and cattle gained 2.90, 3.39, and 3.45 lb/d day for the urea, soybean meal, and DGS diets, respectively. Within this trial, F:G improved from 5.29 for the urea treatment to 4.74 for the DGS treatment. In another trial by Felix et al. (2014) cattle were fed a 90% corn silage diet with 1.37, 1.74, or 2.11% urea. This increased CP of the diet from 12.9 to 15.4% and resulted in a linear increase in F:G

(5.80 to 6.15) as urea in the diet increased. Supplying equal or even greater amounts of CP does not result in equal performance and correctly formulating diets on an MP basis is critical.

The response to DGS in these trials is not solely due to its RUP content. Therefore, 2 trials were done with individually fed cattle to evaluate the response to increasing amounts of RUP supplement [Hilscher et al., 2016 (Table 2); Oney et al., 2017(Table 3)]. The supplement was a blend of SoyPass (50% CP, 75% of CP is RUP) and Empyreal (Cargill Corn Milling, Blair, NE; 75% CP, 65% of CP is RUP). Between the 2 trials, 9 levels of supplement were offered from 0 to 13% of diet DM. The highest level of supplement provided 5.5% of diet DM as RUP. With the combined data there was a quadratic increase in ADG as supplement increased, going from 2.50 lb/d to 3.05 lb/d with a peak at approximately 3.2% RUP. Supplementing the RUP improved both ADG and F:G by meeting MP requirements, interim BW measurements suggest this response was even more apparent early in the feeding period when MP requirements of growing calves are greatest. The first 30 days of a growing period are a critical time for RUP supplementation.

At this time the most economical source of RUP is DGS. Feeding corn silage with DGS will promote good growth (up to 4 lb ADG) fairly efficiently. Comparing 2 trials feeding 15 or 21% DGS in corn silage growing diets shows increased ADG (3.62 vs 4.17 lb/d) and increased efficiency (5.86 vs 4.98 F:G) for the 21% DGS (Hilscher et al., 2018; Ovinge et al., 2019). These treatments have not been evaluated within the same trial; however, it appears that blending corn silage and DGS gives great opportunity to program feed or target a desired level of gain. The economics of feeding these diets is constantly changing and will be addressed by others at this conference (Accurately Pricing Corn Silage; Terry Klopfenstein and Henry Hilscher).

With high quality corn silage and a little protein calves can grow at a rate approaching 3 lb/d. Utilizing DGS to provide some of the CP as RUP can increase gain beyond 3.5 lb/d. Formulating diets to meet the MP requirements of cattle is very important in order to be able to optimize the blend of corn silage and DGS and reach target body weight gains. This is especially true early in the growing period when MP requirements are greatest.

TABLE 1.

Summary of trials feeding corn silage diets to growing cattle

	% of diet DM					
REFERENCE	Silage	CP	RUP[1]	Initial BW, lb	ADG, lb	Feed:Gain
Folmer, 2002[2]	90	12.4	2.24	619	2.95	6.33
Weber, 2011[3]	80	13.0	3.69	613	3.61	5.75
Hilscher, 2018[4]	80	13.3	3.67	714	3.62	5.86
Ovinge, 2019[5]	75	15.1	4.76	699	4.17	4.98

[1] Assuming RUP content of corn silage is 10% of CP
[2] 101 d trial, 128 steers fed in 16 pens
[3] 86 d trial, 240 steers fed in 20 pens
[4] 76 d trial, 216 steers fed in 18 pens (data shown are from control treatment; 72 steers and 6 pens)
[5] 70 d trial, 288 steers fed in 36 pens (data shown are from control 75% silage treatment; 48 steers and 6 pens)

TABLE 2.

Effects of increasing RUP in silage based growing diets on steer performance

	Treatments[1]					P - value	
Variable	0.5%	1.4%	2.4%	3.3%	4.2%	Lin.	Quad.
Initial BW, lb	595	597	597	596	600	0.98	0.60
Ending BW, lb	791	824	855	842	868	< 0.01	0.88
ADG, lb	2.51	2.91	3.31	3.15	3.43	< 0.01	0.82
Feed:Gain	6.74	6.26	5.71	5.52	5.35	< 0.01	0.57

[1] Adapted from Hilscher et al. (2016). Treatments were based on amount of RUP provided by the supplement (% of diet DM). All cattle were fed 88% corn silage with 0, 2.5, 5.0, 7.5, or 10% SoyPass + Empyreal (% of diet DM).

TABLE 3.

Effects of increasing RUP in silage based growing diets on steer performance

	Treatments[1]					P - value	
Variable	0.4%	1.7%	3.0%	4.2%	5.5%	Lin.	Quad.
Initial BW, lb	605	606	604	608	604	0.99	0.86
d 1-37							
Interim BW, lb	692	707	713	730	729	0.03	0.26
ADG, lb	2.34	2.74	2.96	3.29	3.38	< 0.01	0.06
Feed:Gain	6.45	5.62	5.24	4.83	4.48	< 0.01	0.10
d 38-83							
Ending BW, lb	808	833	829	864	857	0.01	0.17
ADG, lb	2.52	2.74	2.51	2.92	2.78	0.10	0.28
Feed:Gain	6.58	6.76	7.30	6.33	6.54	0.64	0.86

[1] Adapted from Oney et al. (2017). Treatments were based on amount of RUP provided by the supplement (% of diet DM). All cattle were fed 85% corn silage with 0, 3.25, 6.5, 9.75, or 13% SoyPass + Empyreal (% of diet DM).

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