Use of Silage and New Approaches to Feed in Beef Operations

G. E. Erickson, D. Burken, F. H. Hilscher, C. Oney, L. Ovinge, A. Watson, and J. MacDonald
University of Nebraska-Lincoln

Introduction

Feeding corn silage is not a new concept for finishing beef cattle. Most feedyards process corn silage to be fed as a roughage at low inclusions. In general, corn silage contains 50% forage and 50% grain and is commonly added at 5 to 15% of diet DM in finishing diets. With silage containing 34 to 38% DM (62 to 66% moisture), then proportion in the diet on a DM basis is quite different than proportions on an as-fed basis and conversion is needed when adding ingredients to mix the final diet, thus all percentages are corrected to a DM basis. Most nutritionists feed silage assuming it were 100% forage whereas inclusion should probably be considered on an equal NDF basis to other forages, or assuming it is 50% forage given that the corn content is about 50% on a DM basis. Another consideration is that the grain is very wet high-moisture corn in silage.

With more distillers grains supply and expensive grain years ago, we researched feeding corn silage at greater than usual (i.e., roughage source only) inclusions and the impact on performance and economics of feedlot cattle. Many feedyards in the Midwest are farmer-feeder operations that own their own cattle and crop ground. If priced correctly and shrink is managed, silage is one of the most economical sources of energy which lead to research to maximize inclusion. In addition, numerous technologies may further benefit silage use such as hybrid selection and traits, kernel processing, and different combinations with grain and distillers grains. Lastly, recent laboratory and performance data suggest that the protein in silage is mostly degradable and the RUP content is considerably lower than previously thought (approximately 10% of CP as RUP). This paper will focus on recent research on corn silage inclusion, impact of hybrids, and kernel processing when used in growing and finishing beef systems.

Corn Silage Inclusion

Past research focused on increasing corn silage and replacing corn grain, which was economical at inclusions of 40 to 60% when grain was expensive. The perception was that if grain is cheap, then feeding elevated amounts of corn silage was not economical. However, some yards tend to use silage to “grow”calves as well for a period of 40 to 70 days before stepping them down on silage and up on grain. A silage growing program will normally contain 70% silage or more in the diet.

We have conducted numerous experiments in the past 7 years evaluating elevated amounts of silage for finishing cattle. In 5 experiments that compared 15% inclusion to 45% inclusion for finishing cattle, ADG decreased by 5.2% or 0.2 lb/d (Table 1). In some studies with yearlings, cattle fed 45% silage tended to eat more, with less impact on ADG. In calf-fed studies, feeding 45% silage either resulted in no change in intake or slight decrease compared to feeding 15% so no significant change in DMI. However, feed conversion is consistently poorer with F:G being 6.7% greater for cattle fed 45% silage compared to 15%. In almost all studies (except for two specific examples discussed later), cattle were fed the same days which resulted in cattle being marketed with slightly lower marbling scores and fatness. Despite being economical, no producers have adopted this practice of elevating silage inclusions. Managing the inventory needed in large operations is a limitation, and in general, producers and nutritionists focus on feed conversion. At times, the focus on F:G is at the expense of profitability or cost of gain.

Many feedyards are open to growing cattle for a period prior to finishing. We wanted to evaluate feeding 45% corn silage (on average) by feeding 75% silage for the first half of the feeding period and 15% silage for the second half of finishing, and compare to feeding either 15% or 45% silage continuously over the whole feeding period (Ovinge et al., 2019). In addition, cattle fed 45% silage were consistently less fat than cattle fed 15% silage. Therefore, ultrasound was used and we attempted to slaughter cattle at equal fatness by feeding cattle on the treatments with elevated silage 28 days longer. Cattle fed 75/15 or 45% silage had similar intake, ADG, and F:G to one another (Table 2). However, both treatments resulted in lower ADG and poorer (i.e., greater) F:G than cattle fed 15% silage. Because cattle fed 75/15 or 45% silage continuously were fed 28 days longer to get to similar fatness, HCW was greater for those treatments compared to feeding 15% to get to the same fatness. Two additional experiments have been completed since then evaluating corn silage inclusion with increased days to ensure equal fatness. Wilson et al. (2020) fed 14, 47 or 80% corn silage to steers for 168, 195, or 238 days, respectively, to an equal fat depth of 0.51 inches suggesting the extra days fed were ideal to market on equal fatness. As expected, the extra days and growth potential by feeding more silage lead to increased HCW, but lower ADG. Feeding more silage hurt F:G as expected, but increased profit, even when feeding an extreme amount of silage to finish the cattle (i.e., 80% inclusion). Our assumption is that producers will more readily adopt a high inclusion silage growing program, allow the cattle to increase frame size and final weights (HCW) while yet marketing at ideal fatness when finished.

Very recently, Wilson et al (unpublished) fed 15 or 45% silage for 185 or 213 days to equal fatness to evaluate liver abscesses. In this study, feeding tylosin (Tylan, Elanco Animal Health) was included or not in both base diets as a 2×2 factorial. Cattle fed 45% silage had 27 lb heavier HCW but ADG was decreased by 0.25 lb/d. Feeding tylosin improved feed efficiency by 2.5% in diets with 15% silage, but did not impact efficiency with 45% corn silage. As expected, cattle fed 45% silage were less efficient that cattle fed 15% silage. The major outcome was that liver abscess rate decreased from 34.5% to 19.2% in 15% silage dies when tylosin was fed. No impact was observed on liver abscesses due to tylosin in diets with 45% corn silage which both averaged 12.4% abscess rate.

Brown Midrib Corn Silage

If cattle are going to be fed 45% silage in feedlot diets, other technologies may be beneficial if fiber digestion can be improved. One example would be use of brown midrib corn silage hybrids. Hilscher et al. (2018a) evaluated feeding a brown midrib hybrid or a brown midrib with a softer endosperm compared to a control hybrid on performance. At 15% inclusion, the softer endosperm brown midrib hybrid increased gain compared to the other 2 hybrids, but not a large impact due to the brown midrib trait at 15% inclusion (Table 3). However, at 45% inclusion, feeding either brown midrib hybrid increased gain compared to the control hybrid with variable impacts on F:G. In a growing study, the response to brown midrib hybrids improving performance was different than what was observed in the finishing trial. Cattle fed either brown midrib hybrid had dramatically greater intakes compared to control (Table 4). As a result of a 3 lb greater daily DMI, ADG was increased by 0.6 lb/d but no differences were observed in F:G across the 3 silage hybrid treatments. Feeding brown midrib silage growing diets with 80% silage inclusion increases fiber digestion (Table 5) which increases passage, increases DMI, increases ADG, but does not impact F:G in silage growing programs. The reason is that when 80% silage-based diets are fed, intake is limited by gut fill. In finishing diets where intake is limited more by energy, then intake may increase but doesn't appear as dramatic as growing diets. In a followup finishing study with 40% silage inclusion, feeding the same brown midrib hybrids increased DMI by 1.1 to 1.5 lb/d, increased ADG by 0.35 to 0.40 lb/d, and improved F:G by 4.6% compared to a control hybrid (Table 6). Those cattle were very big yearlings consuming an average of over 30 lb of DM daily.

Kernel Processing

In the same study evaluating brown midrib hybrids at 40% inclusion, hybrids were kernel processed or not and the interaction between hybrid and kernel processing was evaluated. No interaction was observed between kernel processing and hybrid. A typical energy response was observed for kernel processing whereby ADG was not impacted by kernel processing silage and feeding it at 40% inclusion. However, steers fed silage that was kernel processed ate less feed to get the same ADG, resulting in a 2.9% improvement in F:G (Table 7). These data suggest that kernel processing of silage is worth about 7.25% improvement in F:G assuming the entire change in F:G is due to improving the silage fed at 40% of the diet (2.9%/0.4). A different recent growing silage study that evaluated kernel processing with silage inclusion of 80% of diet DM suggests a 6.6% improvement in the silage due to kernel processing (Brinton et al., 2020).

Silage in Growing Diets

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. 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).

Therefore, 2 trials were done with individually fed cattle to evaluate the response to increasing amounts of RUP supplement [Hilscher et al., 2016 (Table 8); Oney et al., 2017(Table 9)]. 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. 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.

Conclusion

If corn silage is priced correctly, then feeding 2 or 3 times more silage to finishing cattle will result in poorer feed conversion by about 5%. This is dependent on silage hybrids and kernel processing. If more silage is going to be used during finishing, having sufficient bypass protein from distillers grains is important. Most of these studies used 20% or more distillers grains on a DM basis. If producers don’t want to use 45% silage, but want to grow cattle on high-silage diets and step them down halfway through, then performance is the same as if feeding 45% silage continuously. In addition, cattle can be fed a bit longer and to heavier weights prior to getting too fat. Those economics get complex and need to be explored by individual operations.

Literature Cited

Brinton, M. M., B. M. Boyd, F. H. Hilscher, L. J. McPhillips, J. C. MacDonald, and G. E. Erickson. 2020. Evaluating Syngenta Enogen Feed corn silage or grain on growing beef cattle performance. Neb. Beef Cattle Rep. MP108:21-23.

Burken, D. B., B. L. Nuttelman, T. J. Klopfenstein, and G. E. Erickson. 2013a. Feeding elevated levels of corn silage in finishing diets containing MDGS. Neb. Beef Cattle Rep. MP98:74-75.

Burken, D. B., T. J. Klopfenstein, and G. E. Erickson. 2013b. Economics of feeding elevated levels of corn silage in finishing diets containing MDGS. Neb. Beef Cattle Rep. MP98:76-77.

Burken, D. B., B. L. Nuttelman, T. J. Klopfenstein, and G. E. Erickson. 2014. Feeding elevated levels of corn silage and MDGS in finishing diets. Neb. Beef Cattle Rep. MP99:88-89.

Burken, D. B., B. L. Nuttelman, M. J. Jolly-Briethaupt, J. L. Harding, S. E. Gardine, T. J. Klopfenstein, J. C. MacDonald, and **G. E. Erickson**. 2017. Digestibility and performance of steers fed varying inclusions of corn silage and modified distillers grains with solubles to partially replace corn in finishing diets. Transl. Anim. Sci. 1:382-396. *doi:10.2527/tas2017.0046*

Burken, D. B., B. L. Nuttelman, J. L. Harding, A. L. McGee, K. M. Sudbeck, S. E. Gardine, T. C. Hoegemeyer, T. J. Klopfenstein, and **G. E. Erickson**. 2017. Effects of agronomic factors on yield and quality of whole corn plants and the impact of feeding high concentrations of corn silage in diets containing distillers grains to finishing cattle. Transl. Anim. Sci. 1:367-381 *doi:10.2527/tas.2017.0045*

Hilscher, F.H., R.G. Bondurant, J.L. Harding, T.J. Klopfenstein, and G.E. Erickson. 2016. Effects of protein supplementation in corn silage growing diets harvested at 37 or 43% DM on cattle growth. Nebraska Beef Cattle Report MP 103:49-51.

Hilscher, F. H., C. J. Bittner, J. N. Anderson, and G. E. Erickson. 2018. Evaluation of brown midrib corn silage for growing and backgrounding beef steers. Neb Beef Cattle Rep. MP105:47-48.

Hilscher, F. H., M. L. Jolly-Breithaupt, J. L. Gramkow, H. C. Wilson, M. M. Norman, J. N. Anderson, and G. E. Erickson. 2018. Nutrient digestibility and fermentation of brown midrib corn fed to growing beef steers. Neb Beef Cattle Rep. MP105:49-51.

Hilscher, F. H., C. J. Bittner, J. N. Anderson, and G. E. Erickson. 2018. Evaluation of corn silage hybrids with the brown midrib trait and silage inclusion for finishing cattle. Neb Beef Cattle Rep. MP105:86-88.

Oney, C.R., J.K. Gramkow, F.H. Hilscher, E. Schumacher, A.K. Watson, G.E. Erickson, J.C. MacDonald, and T.J. Klopfenstein. 2018. Rumen undegradable protein content and digestibility of corn silage and high-moisture corn. Nebraska Beef Cattle Report MP 105:52-54.

Oney, C.R., F.H. Hilscher, R.G. Bondurant, A.K. Watson, G.E. Erickson, and T.J. Klopfenstein. 2017. Effect of increasing supplemental rumen undegradable protein (RUP) on performance of calves fed a silage growing diet. Nebraska Beef Cattle Report MP 104:27-28.

Ovinge, L. A., F. H. Hilscher, C. J. Bittner, B. M. Boyd, J. N. Anderson, and G. E. Erickson. 2018. Effects of kernel processing at harvest of brown midrib corn silage on finishing performance of steers. Neb Beef Cattle Rep. MP105:89-91.
Ovinge, L. A., F. H. Hilscher, B. M. Boyd, J. N. Anderson, and G. E. Erickson. 2019. Effects of varying levels of silage inclusion and brown midrib corn silage on finishing performance of steers. Neb. Beef Cattle Rep. MP106:69-71.
Wilson, H. C., F. H. Hilscher, B. M. Boyd, A. K. Watson, J. C. MacDonald, and G. E. Erickson. 2020. Impact of essential oils blend on beef cattle performance and carcass characteristics in diets with increasing corn silage inclusions. Neb. Beef Cattle Rep. MP108:71-74.
Wiseman, A. R., Z. E. Carlson, L. J. McPhillips, A. K. Watson, G. E. Erickson, and S. L. Tilton. 2020. Evaluation of RUP content of NextPro dried distillers grains plus solubles and their effect on growing calf performance in corn silage based diets. Neb. Beef Cattle Rep. MP108:38-40.
Xiong, J., B. M. Boyd, L. McPhillips, K. Vosburgh, and G. E. Erickson. 2020. Evaluation of Masters Choice corn silage on growing steer performance. Neb. Beef Cattle Rep. MP108:24-26.

Table 1. Effect of 15% or 45% corn silage (DM basis) on performance and carcass characteristics across 5 experiments.

	Treatment[1]		
Item	15	45	*P*-Value
Pens, n	58	58	
Performance			
DMI, lb/day	24.5	24.9	0.17
ADG, lb[2]	3.86	3.66	<0.01
Feed:Gain[2]	6.29	6.71	<0.01
Carcass Characteristics			
HCW, lb	865	861	0.40
Marbling Score[3]	458	446	0.02
Backfat Thickness, in	0.555	0.537	0.07

[1] Across 5 experiments, 22 pens of yearlings, 36 pens of calf-feds. Diets fed with either 20 or 40% distillers grains.

[2]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[3]Marbling Score 400-Small^{00}, 500 = Modest^{00}

Table 2. Effect of growing cattle on corn silage at 75% followed by 15% compared to cattle fed 15% or 45% continuously, with cattle fed elevated silage longer to equal fatness (Ovinge et al., 2019).

	Treatment[1]			
Item	15	45	75/15	*P*-Value[2]
Pens, n	12	12	12	
DOF, d	153	181	181	
Performance				
DMI, lb/day	23.7	23.6	23.0	0.09
ADG, lb[3]	4.02[a]	3.82[b]	3.73[b]	<0.01
Feed:Gain[3]	5.88[a]	6.18[b]	6.17[b]	<0.01
Carcass Characteristics				
HCW, lb	829[a]	877[b]	866[b]	<0.01
Dressing Percentage	62.73[a]	61.65[b]	61.75[b]	<0.01
LM Area, in^2	13.13[a]	13.51[ab]	13.64[b]	0.05
Marbling Score[4]	460	480	473	0.32
Backfat Thickness, in	0.53[a]	0.60[b]	0.55[ab]	0.05
Liver Abscesses, %[5]	6.25	2.08	3.13	-

[a,b]Means with different superscripts differ ($P < 0.05$).

[1] Treatments were 15% silage inclusion, 45% silage inclusion, and 75 to 15% silage inclusion

[2]*P*-value for the main effect of corn silage inclusion

[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[4]Marbling Score 400-Small^{00}, 500 = Modest^{00}

[5]Liver abscess data did not converge

Table 3. The effects of silage inclusion and silage hybrid on feedlot performance and carcass characteristics in calf fed steers (Hilscher et al., 2018a Beef Report).

	Treatments[1]									
	15% corn silage			45% corn silage						
	CON	BM3	BM3-EXP	CON	BM3	BM3-EXP	SEM	Int.[2]	Concentration[3]	Hybrid[4]
Feedlot performance										
DMI, lb/d	21.5	22.1	21.8	22.3	22.4	23.0	0.3	0.19	< 0.01	0.11
ADG[5], lb	3.73^{b}	3.73^{b}	3.88^{a}	3.49^{c}	3.67^{b}	3.68^{b}	0.04	0.05	< 0.01	< 0.01
Feed:Gain[6]	5.77^{b}	5.92^{c}	5.63^{a}	6.38^{e}	6.09^{d}	6.26^{e}	-	0.01	< 0.01	0.45
Carcass Characteristics										
HCW, lb	882^{b}	880^{b}	898^{a}	855^{c}	875^{b}	877^{b}	4.3	0.04	<0.01	< 0.01
Dress, %	64.05^{b}	64.15^{a,b}	64.64^{a}	62.75^{c}	63.89^{b}	63.87^{b}	0.19	0.03	< 0.01	< 0.01
12th rib fat, in	0.56	0.55	0.59	0.47	0.49	0.52	0.02	0.76	< 0.01	0.23
Marbling score	451	455	475	413	425	443	10.0	0.90	< 0.01	0.03

^{a,b,c,d,e} Means with different superscripts differ ($P < 0.05$).

[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm

[2] Silage Concentration × Silage hybrid interaction

[3] Fixed effect of silage concentration

[4] Fixed effect of silage hybrid

[5] Final BW calculated based on HCW / common dressing percent of 63.8%

[6] F:G was analyzed as gain to feed.

[7] Marbling score 400 = small^{00}, 500 = modest^{00}

Table 4. Effects of feeding two different *bm3* corn silage hybrids on growing steer performance (Hilscher et al., 2018b).

	Treatments				
Variable	CON	BM3	BM3-EXP	SEM	P-value
Initial BW, lb	714	713	714	0.7	0.80
Ending BW, lb	989[b]	1035[a]	1032[a]	4.9	< 0.01
DMI, lb/d	21.2[b]	24.0[a]	24.1[a]	0.2	< 0.01
ADG, lb	3.62[b]	4.23[a]	4.19[a]	0.06	< 0.01
Feed:Gain[2]	5.86	5.67	5.74	-	0.26

[a,b,c] Means with different superscripts differ ($P < 0.05$).

[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm.

[2.] Feed:Gain was analyzed as gain to feed, the reciprocal of feed:gain.

Table 5. Effects of feeding two different bm3 corn silage hybrids on intake and digestibility of nutrients (Hilscher et al., 2018c).

	Treatments[1]				
Item	Control	BM3	BM3-EXP	SEM	P-Value
DM					
Intake, lb/d	15.0	16.5	16.2	1.1	0.11
Digestibility, %	64.5	67.7	69.0	1.6	0.11
OM					
Intake, lb/d	13.8	15.1	15.1	1.0	0.11
Digestibility, %	66.8[b]	70.0[ab]	71.6[a]	1.4	0.05
NDF					
Intake, lb/d	5.9	6.5	6.1	0.4	0.08
Digestibility, %	45.3[b]	57.8[a]	57.0[a]	2.2	<0.01

[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm.
[a,b,c] Means with different superscripts differ ($P < 0.05$).

Table 6. Main effect of corn silage hybrid on cattle performance and carcass characteristics with silage fed at 40% of diet DM to finishing yearlings (Ovinge et al., 2018).

	Treatment[1]				
Item	Control	*bm3*	*bm3*-EXP	SEM	*P*-Value[2]
Pens	12	12	12		
Performance					
Initial BW, lb	882	882	882	11.8	1.00
Final BW, lb[3]	1310[a]	1347[ab]	1354[b]	13.7	0.07
DMI, lb/day	31.3[a]	32.4[b]	32.8[b]	0.33	0.01
ADG, lb[3]	4.12[a]	4.47[b]	4.54[b]	0.058	0.01
Feed:Gain[3]	7.58[a]	7.24[b]	7.22[b]	-	0.04
Carcass Characteristics					
HCW, lb	826[a]	849[ab]	853[b]	8.7	0.07
LM Area, in^2	12.5	12.5	12.5	0.09	0.99
Marbling Score[4]	476[a]	516[b]	511[b]	7.1	0.01
Backfat Thickness, in	0.54	0.58	0.56	0.015	0.20
Liver Abscesses, %	9.09	4.73	6.46	2.86	0.56

[a,b]Means with different superscripts differ ($P < 0.05$).

[1] Treatments were control (CON; hybrid-TMF2H708), a *bm3* hybrid (*bm3*; hybrid-F15579S2), and an experimental *bm3* hybrid (*bm3*-EXP; hybrid-F15578XT) with a softer endosperm

[2]*P*-value for the main effect of corn silage hybrid

[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[4]Marbling Score 400-Small^{00}, 500 = Modest^{00}

Table 7. Main effect of kernel processing of corn silage when fed at 40% of diet DM on growth performance and carcass characteristics (Ovinge et al., 2018)

	Treatment[1]			
Item	-KP	+KP	SEM	*P*-value[2]
Pens, n	18	18		
Performance				
Initial BW, lb	882	882	9.6	0.99
Final BW, lb[3]	1337	1338	11.2	0.96
DMI, lb/day	32.6	31.8	0.27	0.04
ADG, lb[3]	4.38	4.38	0.047	0.93
Feed:Gain[3]	7.45	7.24	-	0.10
Carcass Characteristics				
HCW, lb	842	843	7.1	0.96
LM Area, in^2	12.5	12.5	0.07	0.78
Marbling Score[4]	501	501	5.9	0.97
Backfat Thickness, in	0.56	0.56	0.012	0.70
Liver Abscesses, %	4.60	9.23	2.32	0.34

[1]Treatments were not kernel processed (-KP) or kernel processed (+KP)
[2]*P*-Value for the main effect of kernel processing
[3]Calculated from hot carcass weight, adjusted to a common 63% dressing percentage
[4]Marbling Score 400 = Small^{00}, 500 = Modest^{00}

Table 8. Effects of increasing RUP in silage based growing diets on steer performance (Hilscher et al., 2016)

	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] 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 9. Effects of increasing RUP in silage based growing diets on steer performance (Oney et al., 2017)

	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] 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).