SILAGE FOR BEEF CATTLE
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FEEDING PROGRAMS FOR SILAGE IN FINISHING CATTLE

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Introduction

Feeding corn silage is not a new concept for finishing beef cattle. Most feedyards process corn silage to be fed as acroughage 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. Please note that all proportions discussed in this paper are inclusions on a DM basis in 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. 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.

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 contained 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 one 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., 2018 Midwest ASAS abstract). 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.

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 (data unpublished).

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.

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TABLE 1.

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

	Treatment1		
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-Small00, 500 = Modest00

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., 2018a Midwest ASAS abstract).

	Treatment1			
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]	13.51a[b]	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-Small00, 500 = Modest00

[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).

	Treatments1									
	15% corn silage			45% corn silage						
	CON	BM^3	BM^3-Exp	CON	BM^3	BM^3-EXP	sem	Int.[2]	Concen-tration[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
ADG5, 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 = small00, 500 = modest00

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	989b	1035a	1032a	4.9	< 0.01
DMI, lb/d	21.2b	24.0a	24.1a	0.2	< 0.01
ADG, lb	3.62b	4.23a	4.19a	0.06	< 0.01
Feed:Gain2	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., 2018b beef report).

	Treatment1				
Item	**Control**	**bm3**	**bm3-EXP**	**SEM**	**P-Value2**
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-Small00, 500 = Modest00

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., 2018b beef report)

	Treatment1		SEM	
Item	**KP**	**+KP**	**-**	**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

REFERENCES

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., 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.

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.