



Utilization of Mature Switchgrass as Roughage in Feedlot Diets

The CenUSA Bioenergy project is focused on creating a bioenergy industry based on pyrolysis of perennial grass biomass to create liquid fuels. The increased production of perennial grasses on land that is unsuitable or marginal for row crop production would help minimize soil erosion and nutrient runoff, thereby promoting a more sustainable agricultural system, complementing the Nutrient Reduction Strategy, and helping to protect our nation's water supply. Incorporation of perennial grass hay into beef feedlot rations could create additional marketing options and incentives for farmers to produce greater amounts of perennial grasses. The beef feedlot producer also stands to gain additional roughage sources that will become increasingly important as the cellulosic ethanol industry begins to compete with the livestock industry for cornstalk residue and other forms of fiber and roughage.

Switchgrass is a warm-season grass native to the North American Prairies that has been identified as a model perennial grass to be used for bioenergy production. With the industry of cellulosic biomass conversion to biofuel still in its infancy, there is interest in the establishment of alternative uses and baseline value for mature switchgrass. The use of switchgrass for forage is complicated by the inverse relationship between yield and forage quality. Switchgrass is sometimes grazed by beef cattle or harvested as hay to be used in beef cattle diets, but mature switchgrass grown to maximize yield is nutritionally a low quality forage.

Typical Midwest feedlot diets utilize corn and corn coproducts as concentrated sources of energy and protein, and are balanced using protein, vitamin, and mineral supplementation as necessary. Feedlot finishing rations must include enough roughage to ensure rumen function and can often use low quality forage to achieve a balanced and economical diet. Mature switchgrass could potentially be effectively used as a roughage source despite its low overall nutritional value.

Feed trial compared roughage sources

A feed trial was completed at the Iowa State University Armstrong Research Farm to evaluate the utilization of untreated mature switchgrass as a roughage source in feedlot diets. The hypothesis was that mature switchgrass could effectively be used as a roughage source in feedlot diets. Mature switchgrass harvested after frost was used in the trial. Performance and carcass characteristics of cattle fed switchgrass as roughage versus cattle fed cornstalks as roughage were compared.

Initial nutritional analysis reinforced that mature switchgrass is indeed low quality forage. Nutritional analysis of the switchgrass hay revealed crude protein to be approximately 2.35%, Neutral Detergent Fiber (NDF) to be approximately 79%, Total Digestible Nutrients (TDN) to be approximately 48%, and Net Energy for Gain

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Cenusa bioenergy, a USDA-funded research initiative, is investigating the creation of a sustainable Midwestern biofuels system.

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(NEg) calculated from Acid Detergent Fiber (ADF) to be approximately 15%. Nutritional values were somewhat similar to those of cornstalks produced at the Armstrong Research Farm. Nutritional analysis of the cornstalks showed crude protein to be approximately 4.6%, NDF to be approximately 80%, TDN to be approximately 48%, and NEg calculated from ADF to be approximately 30%.

The study of 247 steers included four replicates and two turns of cattle fed during the summer months of 2014 and 2015. Each year steers were randomly allocated to one of four pens, with approximately 30 head per pen. Steers were fed in a typical commercial feedlot environment that included open lot with shelter over the bunk and apron, and earthen mounds in dry lot area. Cattle were implanted with Revalor IS early in the feeding period and again on approximately day 75 of the feeding period. Optaflexx was fed for approximately the last 30 days on feed.

Steers were randomly allocated to receive either cornstalks (STALK) or switchgrass (SWITCH) as roughage. Diets included corn, modified distillers grains, mineral supplement, and one of the two roughage sources. Based on initial nutrient analyses, diets were developed to be equivalent in percent dry matter of each feedstuff. Finishing rations across treatments contained 14.2% roughage on a dry matter basis, and STALK and SWITCH were similar in total NDF with levels of approximately 29%. Finishing rations were formulated to be comparable across treatments in terms of NEg with STALK rations providing

approximately 0.62 Mcal/lb and SWITCH rations providing approximately 0.60 Mcal/lb. Cattle were fed ad libitum and bunks were managed to achieve nearly slick bunks each morning. Each year cattle were marketed on a common date based on estimated degree of finish, and carcass data were collected.

Carcass and performance data are reported in Table 1. Statistical analysis revealed a Treatment by Year (Trt*Year) interaction for Dry Matter Intake (DMI) and a tendency for a Treatment by Year (Trt*Year) interaction for Marbling score. Cattle fed in 2014 had greater Kidney, Pelvic, Heart Fat (KPH) at harvest and tended to have greater Gain to Feed ratio (G:F) ratio over the feeding period as compared to cattle fed in 2015. No treatment effect was noted as performance measurements and carcass characteristics did not differ based on roughage source. SWITCH cattle were successfully fed to market weight with performance and carcass data very comparable to the control STALK cattle.

These data support the hypothesis that mature untreated switchgrass may replace cornstalks at low inclusions in beef feedlot finishing diets. Although mature switchgrass is low in digestible nutrients, it seems to offer enough effective fiber to maintain rumen function and promote digestive health. These findings support the idea that the feedlot industry could utilize mature switchgrass as an alternative roughage source, thereby providing an additional marketing option for switchgrass beyond the biofuel industry.

Table 1. Comparison of cornstalks and switchgrass as roughage sources in feedlot beef diets.

Item	Treatment ¹		SEM	P-Value		
	STALK	SWITCH		Trt	Year	Trt*Year
Performance measurements						
ADG ² , lb	3.79	3.71	0.074	0.55	0.28	0.49
DMI, lb	26.6	25.6	0.03	<0.0001	<0.0001	0.03
G:F, lb:lb	0.143	0.145	0.0030	0.63	0.09	0.65
Carcass characteristics						
Final BW ³ , lb	1343	1330	12.8	0.51	0.93	0.49
HCW, lb	846	838	8.1	0.51	0.92	0.49
12 th rib back fat, in	0.49	0.47	0.010	0.27	0.15	0.14
KPH, %	2.2	2.1	0.04	0.37	0.002	0.37
LM area, in ²	13.4	13.5	0.13	0.74	0.22	0.82
Yield grade	3.1	3.0	0.04	0.16	0.28	0.13
Marbling score ⁴	1032	1020	4.3	0.11	0.04	0.10

Appreciation is extended to Garland Dahlke, Dallas Maxwell, and the Armstrong Research Farm Staff for helping to conduct this research.

June 2016

¹Treatment based on roughage fed: STALK fed cornstalks and SWITCH fed switchgrass.

²Carcass-adjusted ADG calculated from HCW and 63% dressing percentage.

³Carcass-adjusted Final BW calculated from HCW and 63% dressing percentage.

⁴Marbling score: 900 = Slight 0, 1000 = Small 0, 1100 = Modest 0, etc.

This project is supported by Agriculture and Food Research Initiative Competitive Grant No. 2011-68005-30411 from the National Institute of Food and Agriculture.

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