

Getting the Most Benefit From Feed Ingredients

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Forage is the basal feed of greatest importance to beef cattle producers. High quality forage can be grown on land marginal for grain or other crop production due to fertility or erosion potential. Cattle can readily convert this forage into a high quality human food supplying protein, energy and many of the trace elements we need. Producers should ask themselves if forage by itself is suitable for beef production or are there times when cattle consuming forages require supplementation?

There are at least 3 good reasons to supplement cattle consuming forage rations. Producers should supplement to 1. improve animal performance, 2. stretch the forage supply and 3. improve economic return to the enterprise. Before beginning a supplementation program, producers must determine if what is supplemented has an effect on animal performance and if timing of supplementation affects performance. Understanding the associative effects of digestion will help producers determine what to use as a supplement so that best utilization of all feedstuffs occurs. The associative effects of digestion simply mean that a given feed can affect the digestion of another feed in the rumen. These effects can be either negative or positive. In general, starch (grains) has a negative effect on fiber or forage rumen digestibility while proteins have a positive effect especially if total ration protein or degradable intake protein is low. These effects can be very important to producers. They allow some high fiber by-product feeds to have a higher effective energy value than corn on a pound for pound basis. Data in Table 1 illustrates the negative associative effects of digestion. Cows were fed a good quality

Table 1. Intake and Digestibility of Hay by Cows fed Increasing Levels of Corn				
Corn, lbs	None	2.2	4.4	6.6
Hay, DMI, lbs	19.3	18	14.1	11.2
% B. Wt.	2.3	2.14	1.66	1.32
Total DMI, lbs	20.9	21.1	18.6	17.2
Starch Intake, lbs	-----	1.48	2.95	4.74
DIP Intake, gm	153	130	106	84
DOMI, lbs	7.5	8.4	7.1	7.3
Hay Digest. %	36.5	35.1	23.6	18.9
JAS 65:557				

grass hay free choice and either no corn or increasing levels of corn with the hay. As corn intake increased, hay intake decreased. As corn intake increased, starch intake increased and DIP intake decreased. Corn is an excellent source of starch and a poor source of DIP. The rumen bacteria that digest starch are different from the bacteria responsible for digesting fiber. As more starch is supplied, the bacteria responsible for

utilizing it increase in number and produce more acid, thus lowering the rumen pH. As the environment in the rumen becomes more acidic, the population of fiber digesting bacteria decreases. DIP is a nutrient needed by rumen bacteria in order to maximize rumen fermentation. Thus two negatives occur from the increasing supplementation of corn. First, we decrease the number of fiber digesting bacteria and we deprive those remaining of an essential nutrient needed for digestion of fiber. As shown in the last two lines of the table, the digestibility of the hay decreased by 50% and the total nutrient intake of the cows was actually less with 6.6 pounds of corn supplementation than when no corn was supplemented.

An application of the above phenomena to grazing steers is shown in Table 2. Corn was supplemented in increasing amounts to 500 pound steers grazing fescue. The first increment of corn was .25% of body weight and provided for an excellent response in gain and conversion of supplemental feed to gain. An additional .25% of body weight in supplemental corn gave no increase in performance. Increasing the supplementation to .75 % body weight provided for an additional small increase in gain with poor conversion rate. The first increase was not sufficient to interfere with pasture digestion and an excellent gain response was obtained. Additional increases of corn had a negative effect on pasture digestion so gain response was limited. As we added more energy from corn, we took away nutrients from pasture digestion.

Lbs Corn	ADG, lbs	ADG ↑	F/G, lbs
0	1.32	-----	-----
1.4	1.75	.43	3.25
2.8	1.75	0.0	-----
4.2	2.00	.25	11.25

Kentucky, 1995

Some commonly available by-product feeds that are low in starch but high in energy are shown in Table 3. Dried distillers grains with solubles, dried brewers grains, soybean hulls, corn gluten feed and wheat midds are all readily available to producers. All are higher in protein and lower in starch compared to corn grain. The energy or calculated TDN value may be lower than corn although the true value may be higher when used in forage based rations. The remainder of the paper will deal with trials demonstrating these phenomena.

Feed	CP, %	DIP, % CP	UIP, % CP	TDN, %	Starch, %
DDG/S	30.4	48	52	90	18
DBG	29	50	50	66	10.7
SBH	12	75	25	77	6
CGF	23.8	78	22	80	25.4
Wheat Midds	18.7	79	21	69	37.8

NRC – Beef 2000 Update, PAS 16:69 - 99

Data in Tables 4 and 5 compare the effects of by-product based rations to corn based rations for short term preconditioning of calves for either 45 or 48 days. In both cases, calves were provided free choice access to hay. In the 48 day trial shown in Table 4, calves were provided free choice access to either a corn – soybean meal mixture or a soybean hull – soybean meal mixture. Calves ate more of the soybean hull based ration and gained over a pound per day more than calves consuming the corn based ration. In the 45 day trial, calves were fed equal amounts of either a corn – soybean meal mixture or a soybean hull – corn gluten feed blend. Calves consuming the by – product based blend gained .6 pounds per head daily more than the calves consuming the corn based ration. This data supports the negative associative effect of corn on fiber digestion and the positive effect of commodity based feeds.

Table 4. Ration Type for Preconditioning Calves, 48 Days		
Ration	Corn/Soybean Meal, 9:1	Soy hulls/Soybean Meal 9:1
Initial Wt. lbs	558	527
Final Wt. lbs	674	693
ADG, lbs	2.42	3.46
Supplement Intake, lbs/day	12.8	17.4
Cost/lb Gain, \$.314	.254
KY. SR-2004-2, p. 17		

Table 5. Ration Type for Preconditioning Calves, 45 Days		
Ration	Corn/Soybean Meal 88:12	Soybean Hull/Corn Gluten 67:33
Initial Wt. lbs	517	516
Final Wt. lbs	628	655
ADG, lbs	2.48	3.08
Supplement Intake, lbs/day	10.4	10.4
Hay Intake, lbs/day	11.8	15.1
Cost/lb Gain, \$.33	.27
KY. SR-2004-2, p. 18		

The results of feeding yearling steers a corn based ration or straight soybean hulls when either grazing stockpiled fescue or consuming round bales of hay are shown in Table 6. All groups were fed a constant level of 7 pounds of supplement per head daily. Whether grazing or consuming hay, cattle fed the soy hulls out gained the corn based supplement cattle by .4 pounds per head daily. This study well illustrates how corn prevents the best utilization of forage by growing cattle.

The phenomena of negative associative effects of digestion by starch containing feeds can also be seen with cattle grazing spring pastures, Table 7. In this study, cattle were provided with either corn or corn gluten feed at 6 pounds per head daily. In addition, an un-supplemented group of cattle were also compared. Corn did increase gain by .16 pounds per head daily but the gluten supplemented cattle had a .42 pounds per

head daily increase in gain. The phenomena of starch having a negative response on fiber digestion occurs with hay and grazing regardless of whether it is spring or fall grazing.

Table 7. Supplementation and Gain of Steers Grazing Endophyte Fescue in Spring			
Treatment	Control	Corn	Corn Gluten Feed
ADG, lbs	1.40	1.56	1.82
F/G, lbs	-----	37.5	14.2
JAS 76:1691 – 1701, Supplements fed at a daily level of 6 pounds per head			

Table 8. Distillers Dried Grains w/Solubles for Heifers on Hay Rations		
Treatment	Corn Grain	Distillers Dried Grains
ADG, lbs	1.57	1.89
F/G, lbs	9.8	8.0
Nebraska, 2003		

Other commodity feeds such as distillers dried grains are plentiful and also low in starch. The result of a Nebraska study comparing gain of heifers fed either DDG or corn when consuming hay is shown in Table 8. Heifers fed DDG out-gained the corn fed heifers by .32 pounds per head daily. Other by-products such as bakery waste, grain screenings, malt sprouts, whole soybeans and commercial products such as Mix – 30 (a liquid feed) are available. Some of the by-products such as Mix – 30 or whole soybeans are high in fat content and can be useful when the forage available on the farm is endophyte infected fescue as shown in Table 9. In this Kentucky research, cows were grazed on endophyte fescue before and during breeding season without access to shade. They were given free choice access to the liquid feed Mix – 30 or provided with equal energy and protein intake from a corn soybean meal mixture. Cows consuming Mix – 30 gained more weight, had improved body condition score, lower body temperatures and lower thyroxine levels and higher pregnancy rate compared to the corn supplemented cattle. Both supplements were fed beginning 30 days prior to and through the end of breeding season. The high fat supplement allowed for most efficient use of contaminated fescue pasture.

Table 9. Mix – 30 and Reproduction of Beef Cows on Endophyte Fescue		
Treatment	Corn – Soybean Meal	Mix – 30
Change in Temperature °F	+1.5	-.5
Change in BCS	-.2	+2
Serum Thyroxine, ng/ml	40.2	35.1
Pregnancy %	56.4	75.3
2002 KY Ruminant Nutrition Workshop, p. 7		

Timing of supplementation can be very important. Supplements should compliment forage use, not compete with forage utilization. Data in Table 10 illustrates this point very well. Steers grazing Brome pasture were either fed no supplement, 3 pounds of soybean hulls per head every day during the grazing season or 6 pounds per head daily during the last half of the grazing season. Thus both supplemented groups received the same total amount of supplementation. Those receiving the supplement during the last half of the grazing season had an increased daily gain of .31 pounds while

those receiving supplement every day only had an increase in daily gain of .07 pounds. Waiting until the pasture had matured and decreased production improved the utilization of both pasture and supplement.

Table 10. Supplement Timing for Steers Grazing Brome Grass Pasture			
Soybean Hulls	None	3 lbs all season	6 lbs last half of grazing
Steer Wt. lbs	689	689	689
ADG, lbs	1.38	1.45	1.69
F/G, lbs	-----	42	9.7
JAS 66:2959			