Considerations for forage digestibility and dietary intake in cattle fed forages supplemented with SweetPro licktubs.

Institute for Restoration & Shalom – Summer 2011 - Abe Scheaffer, Ph. D.

Dried distillers grains with solubles (**DDGS**) is becoming a staple supplement fed to grazing and forage fed cattle. The value of DDGS to the forage fed ruminant appears to be the increase in digestibility of the neutral detergent fiber (**NDF**) portion of the diet (Islas and Soto-Navarro, 2011). The knowledge base that has grown and been gathered throughout the SweetPro product line has come to the conclusion that at 1.0 lb/hd/d consumption (0.1% body weight (**BW**) of 1000 lb animal) of the pressed block results in an increase in digestibility of the diet. That diet must be forage based, greater than 50% of the total ingredients in the diet must be forage. This increase in digestibility results in a decreased dietary intake in cattle that are mature and consuming a diet that is of adequate quality for them to maintain body condition. That increase in digestibility may also result in an increase in animal performance in growing animals with no change in dietary intake.

These observations require us to look into the possibilities and subsequent outcomes when dietary digestibility might be increased due to SweetPro supplementation. The scientific literature is dramatically increasing in the amount of information available on supplementation of forage fed ruminants with DDGS. In addition, DDGS is a factorial supplement. Dried distillers grains with solubles are a good source of fermentable complex carbohydrates, rumen degradable protein (**RDP**), rumen undegradable protein (**RUP**), and fat. Thus, when evaluating the performance response of forage fed ruminants to supplementation with DDGS it is not appropriate to designate that as a protein or energy response, it is likely a combination of all aspects of DDGS.

The composition of forages is described in figure 1 (Appendix). First the analysis of forage is begun be quantifying the amount of dry matter (**DM**) in a given sample. That is further broken down to ash and organic matter (**OM**), the OM subdivided into neutral detergent fiber (**NDF**) and acid detergent fiber (**ADF**). Within the NDF portion of the OM is neutral detergent solubles (**NDS**). The majority of the nutrients available for ruminant nutrition are in this NDS fraction. The NDS is then made up of neutral detergent soluble carbohydrates (**NDSC**), crude protein (**CP**), and ether extract (**EE**). The further breakdown of these constituents is explained further in figure 1.

The value of feeding DDGS to forage fed ruminants is beyond the nutrient composition of the supplement itself and this response of the rumen environment in the fermentation of forages by the bacteria of the rumen, is a change in dietary digestibility. This has been observed for quite some time that a digestibility of dietary forages could be increased by the addition of corn processing by-products (Hannah et al., 1990). Hannah et al. (1990) demonstrated that when OM of the diet was the same and 20% of the diet was corn gluten feed (**CGF**) digestibility of the NDF in the diet increased from 36.9% to 47.4%, whereas 20% inclusion of corn resulted in NDF digestibility changing from 44.2% to 43.5%. Thus the addition of ethanol production by-products to a forage diet increases the digestion of the NDF fraction of the diet significantly more than adding a concentrate feedstuff. The result of increased NDF digestion is two-fold, *1) there is greater energy available to the animal due to more of the cellulose and hemicellulose being broken down by the cellulytic bacteria that populate the rumen at pH levels above 6.0; and 2) because there* *is greater digestion of cellulose and hemicellulose there is more nutrients available for microbial growth resulting in a greater amount of bacterial protein or microbial protein available to the animal.*

The value of supplementation of forages with DDGS is that when digestibility of the diet is increased, animals will perform as though they are consuming a higher quality diet. Morris et al (2005) found that when supplementing heifers at 1.5 to 6.0 lbs/d with DDGS average daily gain (**ADG**) was increased and dry matter intake was decreased in both good quality alfalfa/sorghum silage and poor quality brome grass hay diets. The difference between the stepwise increase in DDGS supplementation was greatest between the non-supplemented heifers and those receiving 1.5 lbs/d. The positive differential in performance was diminished as the amount of DDGS supplementation increased. These results also illustrate the greater value of DDGS supplemented to lower quality diets. However, this supports the conclusion of Nuttelmann et al (Nuttelman et al., 2009), who found that when supplementing DDGS or dry rolled corn (**DRC**) to 630 lb steers fed a forage based diet composed of sorghum silage and grass hay that the DDGS had 130% the energy value, calculated from steer performance, of DRC.

An interesting variation on the application of DDGS supplementation is in dry lot fed or grazing animals. There is a greater positive response to DDGS supplementation at lower levels (1.5 to 3.0 vs. 6.0 to 7.5 lbs/d) than greater levels of intake (Griffin et al., 2009). In addition, (Morris et al., 2005) the economic advantage of feeding DDGS at 1.5 lbs/d to a brome grass hay diet (53% TDN) was $60 greater than when added to an alfalfa/sorghum silage diet (65% TDN) for each ton of DDGS fed. This also resulted in a $7 advantage per head over the unsupplemented alfalfa/sorghum silage diet and a $17/hd advantage for the brome hay fed heifers. Thus the DDGS had greater nutritional value resulting in a more significant economic advantage when used as a supplement for lower quality forage.

Another segment in the beef production cycle where DDGS supplementation has been evaluated and shown significant value is in grazing replacement heifers (Martin et al., 2007a, Martin et al., 2007b). In these reports, Martin et al. (2007a,b), fed a control supplement at 0.78% BW, or 4.4 lbs/d compared to DDGS supplement fed at 0.59% BW or 3.3 lbs/d. The control supplement was 73% dried corn gluten feed, 24.48% whole corn, and 2.3% urea whereas the DDGS supplement was 99.76% DDGS. These supplements were provided to heifers being fed a medium quality forage approximately 8.5 % CP and 54% TDN. The growth performance of heifers in these two groups was similar. The most significant result was the 41.3% artificial insemination (**AI**) pregnancy rate in heifers getting the control supplement compared to the 55.3% AI pregnancy rate in heifers getting in the DDGS supplement. In addition, a second location was evaluated with these supplementation treatments, which resulted in a 39% AI pregnancy rate for the control supplement heifers and a 58.5% AI pregnancy rate for the DDGS supplemented heifers. These responses in heifer reproductive performance were observed when both groups were provided supplements of equal energy density. These results demonstrate the multifaceted response in forage fed or grazing ruminants to DDGS supplementation.

The consideration of these animal performance and economic value responses due to DDGS supplementation is profound. The full explanation of the diet digestibility response, which is the disproportionate value of DDGS supplementation, is challenging to find direct comparisons of

DDGS to other supplements in forage-based diets. This is due to the focus of research in evaluating the nutritional value of in concentrate fed diets for the feedlot (Klopfenstein et al., 2008, Vander Pol et al., 2009). In order to understand the diet digestibility impacts of the digestible fiber aspect of DDGS it is informative to review other digestible fiber sources. The other digestible fiber sources that have been investigated regarding their impact on diet or forage digestibility are sugar beet pulp (**SBP**) and soybean hulls (**SBH**). The chemical analysis of beet pulp, SBH, and DDGS are shown in Table 1. The chemical analysis alone shows the greater nutritional value of DDGS in comparison to beet pulp and SBH. However, the value of a highly digestible fiber source in total diet digestibility is the unique aspect of the SweetPro product line that is most intriguing.

When evaluating SBH supplementation to steers grazing smooth brome pastures SBH was found to be equivalent to whole corn (Anderson et al., 1988). In this experiment conducted by Anderson et al (1988), corn and SBH were fed at 3.0 lbs/d. Steers grazing brome grass pastures gained 1.32 lbs/d without any supplement, corn supplemented steers gained 1.65 lbs/d, and steers supplemented with SBH gained 1.7 lbs/d. When feeding bermudagrass and dallisgrass hay, Orr et. al. (Orr et al., 2008) demonstrated a significant improvement in dietary digestibility when steers were supplemented with SBH compared to corn. The other digestible fiber source to consider is SBP. Sugar beet pulp supplementation has been compared to corn supplementation in cattle and lambs being fed forages (Mount et al., 2009). This experiment conducted by Mount et al (2008) resulted in some dramatic values of the digestible fiber supplement compared to corn or a starch supplement. This experiment showed greater nitrogen retention (-0.64 g/d for corn vs 1.17 g/d for SBP, decreased fecal fiber (NDF - 127.6 g/d for corn vs 96.2 g/d for SBP; and ADF – 77.7 g/d for corn vs 60.0 g/d for SBP) excretion, and increased fiber digestion (NDF – 57.7 % for corn vs 69.8% for SBP; and ADF – 49.7% for corn vs 66.7% for SBP) in lambs. Recall that this increased fiber digestion results in an increased energy value that the diet consumed. These experiments demonstrate the value of digestible fiber to be equivalent to corn when fed to ruminants fed forage-based diets. Thus the value of DDGS is minimally evaluated to be 100 to 130% the nutritional value of corn grain.

Additionally, (Engel et al., 2008) DDGS has been evaluated in comparison to supplementation of SBH to primiparous heifers. This supplementation regime was implemented 95 d prepartum. Heifers were provided DDGS and SBH supplements in addition to a ground grass hay basal diet. These diets were formulated to be equal in DMI, energy, RDP. The DDGS supplement provided additional RUP and fat. Over a two-year trial all maternal and calf performance measures were similar between treatments. However, the DDGS treatment resulted in a 10% (SBH 84% vs. DDGS 94%) increase in pregnancy rate after a 60 d breeding season. These results highlight the factorial value of feeding a supplement based on DDGS. The difference between the supplements was the total concentration of RUP and fat and likely forage digestibility, although digestibility was not measured in this trial, yet performance was similar. This implies that DDGS supplementation prepartum is a reasonable investment for subsequent reproductive performance of beef females fed forage based diet.

When considering this brief review of DDGS supplementation to forage fed or grazing cattle it can be concluded that there is significant value in supplementation with DDGS. This value is also greater than supplementation with supplements with similar energy density or total amount of

CP. So, when evaluating the SweetPro product line the value in animal performance is significant. However, the SweetPro licktub also delivers a complete vitamin/mineral package. In addition to DDGS, vitamins/minerals, the SweetPro products contain ProBiotein. ProBiotein is the result of yeast fermentation of flax, barley malt, wheat midds, and oats. ProBiotein is a proprietary ingredient in SweetPro products that also aids in the digestibility of forages. The extent of that added digestibility and the portions of the forages it aids in digesting are yet unknown. The ProBiotein may be considered to be something akin to direct fed microbials, but it does not fit well among those peers. Much work remains to be done on understanding the added nutritional and economic value to beef producers due to the addition of ProBiotein to the known values of DDGS.

Citations.

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Appendix.

Figure 1. Feed and Forage Composition.

percentage of feed or forage (↕)

analytical fractions				chemical constituents	other analyses
moisture				water	
dry matter	ash			various minerals plus sand	
	organic matter	NDF	ADF	cellulose	
				lignin	
				fiber-bound N* heat-damaged N*	ADICP, NDICP
				hemicellulose	
		NDS	NDSC	fructans glucans pectic substances	NDSF
				sugars starches organic acids	
			crude protein	NPN (amino acids, amines, urea)	
				true protein – degradable	RDP (DIP)
				true protein – undegradable	RUP (UIP)
			ether extract	esterified fatty acids pigments and waxes	

*Fiber-bound nitrogen and heat-damaged nitrogen are also found in crude protein and RUP.

Source: *John Moore. Professor Emeritus of Animal Sciences, University of Florida.*

(Ball et al.)

Table 1. Chemical analysis of sugar beet pulp, soybean hulls, and dried distillers grains plus solubles.

	Beet Pulp	SBH	DDGS
Crude Protein (%)	9.8	12.1	30
RDP, % of CP	55	50	45
RUP, % of CP	45	50	55
NDF (%)	44.6	67	37
ADF (%)	27.5	50	18
TDN (%)	74	77	90
Fat (%)	0.5	4.0	10
Net Energy – maintenance*	0.78	0.84	1.0
Net Energy – gain*	0.51	0.55	0.70

* Net Energy = Mcal/lb