

GRAIN PROCESSING AND BYPRODUCT INTERACTIONS – AN INDUSTRY PERSPECTIVE

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INTRODUCTION

The availability of corn milling byproducts has increased dramatically in recent years and this is having a tremendous impact on cattle feeding and feeding programs. Others (Erickson and Klopfenstein, 2006; Forester, 2006) have described the differences between the wet milling and dry milling industries and their respective byproducts. In this discussion, the primary foci will be wet corn gluten feed (WCGF) and wet distillers grains (WDG).

The primary question that I was asked to address for this discussion is: Do the results of university studies regarding grain processing and corn milling byproducts agree with field observations of a consulting nutritionist? My immediate thought was "which trials?" because there seems to be disparity among trials. However, disparity may be less than it first appears once the apparent interaction between grain processing and byproduct feeding level are understood. I will not attempt a complete literature review of university trials studying the interaction of grains processing and corn milling products; this already has been done (Cole et al., 2006; Erickson and Klopfenstein, 2006). However, I will discuss several specific trials that predominately agree with my observations in the field, and that describe this apparent interaction quite well.

DISCUSSION

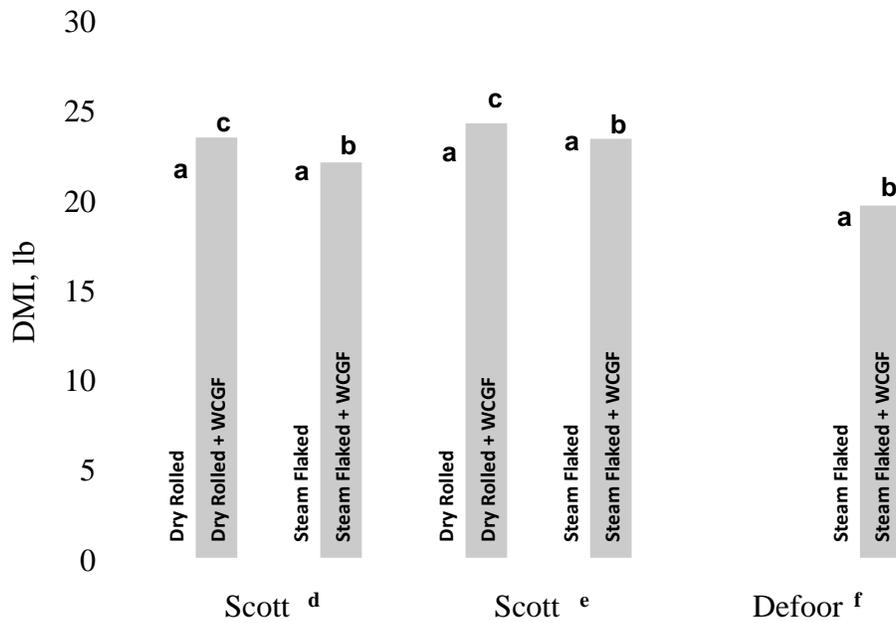
Two primary types of university studies have evaluated grain processing and byproduct interactions. The first typically feeds one or more level of byproduct within a corn processing method and estimates the value of that byproduct relative to the corn that it replaced. The second typically feeds one level of byproduct across two or more corn

processing methods and compares the value of the two processing methods. Both of these types of studies, as well as one which does both, will be discussed below.

Value of Byproducts across Corn Processing Methods

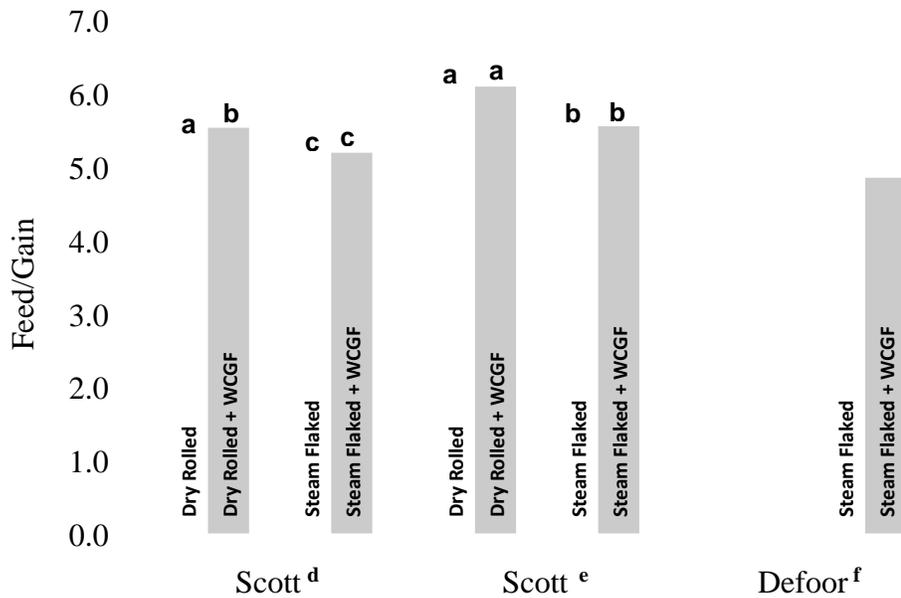
Wet Corn Gluten Feed. Wet corn gluten feed, a byproduct of the wet corn milling industry, basically is a combination of corn bran and steep water from the wet corn milling process. Wet corn gluten feed typically ranges from 40-60% DM depending on which milling facility it comes from, with a typical nutrient content of 18-22% crude protein, 2% fat, and 0.45% sulfur (DM basis). When WCGF is substituted for corn in finishing diets, we typically observe increased DM intake, higher ADG, and similar DM conversions compared to non-byproduct diets. These observations are in agreement with university trials conducted by Scott et al. (2001) and Defoor et al. (2003).

Scott et al. (2001) fed dry rolled corn (DRC) and steam flaked corn (SFC) diets with or without 32% (Trial 1) and 22% (Trial 2) WCGF (DM basis). Defoor et al. (2003) fed SFC diets with or without 25% WCGF (DM basis) and incremental levels of added fat. For this discussion, I will only use the Control diet that contained 3% added fat and the WCGF diet with 3% added fat in the trial of Defoor et al (2003). Performance data for all three trials are shown in Figures 1, 2, and 3. Dry matter intake and ADG were significantly higher ($P < 0.10$) in both trials of Scott et al. (2001) when WCGF was added to the diet. Similarly, DMI was significantly higher ($P < 0.10$) and ADG tended to be higher ($P = 0.11$) when WCGF was added to the diet in the trial of Defoor et al. (2003). Dry matter conversions, however, were similar or slightly inferior in all trials when WCGF was added to the diet.



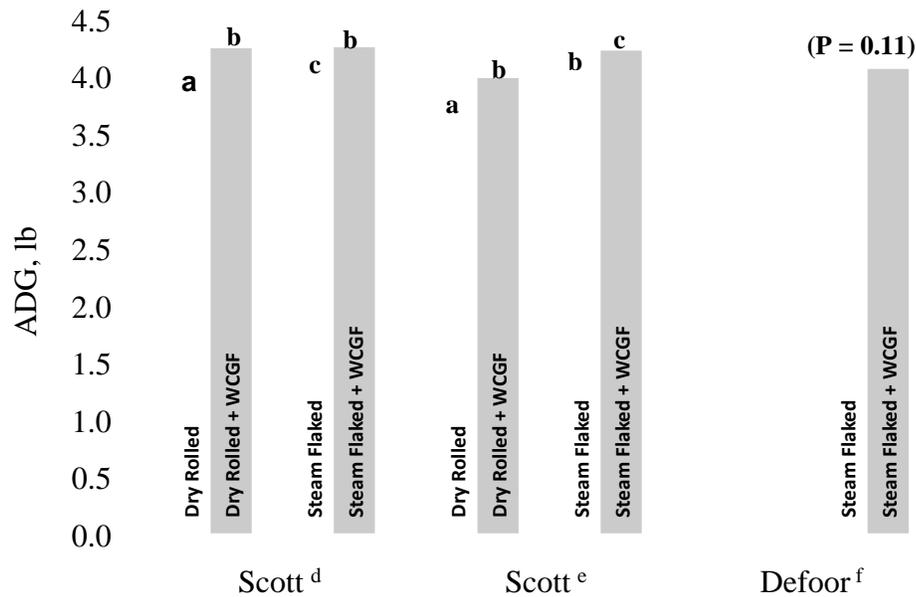
a,b,c Means within trial with unlike superscripts differ ($P < 0.10$).
^dScott et al. (2001), 32% WCGF (Dry matter basis).
^eScott et al. (2001), 22% WCGF (Dry matter basis).
^fDefoor et al. (2003), 25% WCGF (Dry matter basis) with 3% added fat.

Figure 1. Effect of wet corn gluten feed (WCGF) on dry matter intake (DMI) of finishing cattle fed dry rolled corn or steam flaked corn based diets.



a,b,c Means within trial with unlike superscripts differ ($P < 0.10$).
^dScott et al. (2001), 32% WCGF (Dry matter basis).
^eScott et al. (2001), 22% WCGF (Dry matter basis).
^fDefoor et al. (2003), 25% WCGF (Dry matter basis) with 3% added fat.

Figure 2. Effect of wet corn gluten feed (WCGF) on feed/gain of finishing cattle fed dry rolled corn or steam flaked corn based diets.



^{a,b,c}Means within trial with unlike superscripts differ ($P < 0.10$).

^dScott et al. (2001), 32% WCGF (DM basis).

^eScott et al. (2001), 22% WCGF (DM basis).

^fDefoor et al. (2003), 25% WCGF (DM basis) with 3% added fat.

Figure 3. Effect of wet corn gluten feed (WCGF) on average daily gain (ADG) of finishing cattle fed dry rolled corn or steam flaked corn based diets.

The results of these trials by Scott et al. (2001) and Defoor et al. (2003) agree very well with my feedyard observations that WCGF promotes greater DMI and ADG but with similar to slightly poorer DM conversions when substituted for corn. Based on the negligible change in DM conversion, WCGF typically is given an energy value similar to dry corn. However, energy value should not be confused with the overall feeding value of WCGF; feeding value includes many other factors such as the value of additional weight gain, reduced protein supplementation cost, improved ration palatability, and acidosis/bloat control. It is also important to note that all WCGF's are NOT the same, with the primary difference being the amount of steep liquor placed in the product; this affects the energy value of WCGF.

Wet Distillers Grains. Wet distillers grains, a byproduct of the dry milling industry, basically is the concentration of the nutrients in corn or milo once the starch is removed. Its DM content will

typically vary from 32 to 50% depending on the design of the dry milling plant, and this unfortunately can vary at times within a plant. The typical nutrient content (DM basis) is 28 to 32% crude protein, 10 to 12% fat, and 0.45 to 1.2% sulfur. A slight increase in DMI along with significant improvements in ADG and DM conversion typically are observed when WDG is substituted for corn in finishing diets. However, the response appears to depend on level of feeding and grain processing with the optimal level being much lower with SFC diets than with DRC or high moisture corn (HMC) diets.

The results of Vander Pol et al. (2006) and Daubert et al. (2005) agree closely with the response to WDG observed in the field. In diets based on a 50:50 ratio of DRC and HMC, Vander Pol et al. (2006) fed 0, 10, 20, 30, 40, and 50% WDG (DM basis); DMI and ADG responded quadratically ($P < 0.01$) to level of WDG with maximums occurring at the 30% inclusion level (Figure 4).

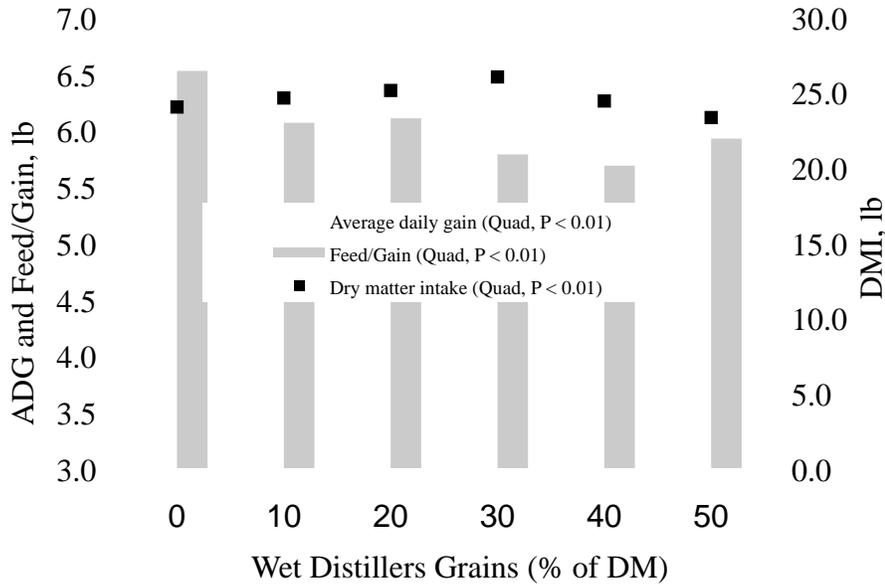


Figure 4. Effect of wet distillers grains added to dry rolled, high moisture corn based finishing diets on steer performance (Vander Pol et al., 2005). ADG, average daily gain; DMI, dry matter intake.

Dry matter conversion also responded quadratically ($P < 0.01$) with 40% being the optimum inclusion level. With SFC diets, Daubert et al. (2005) fed 0, 8, 16, 24, 32, and 40% WDG (DM basis) and observed maximum DMI at 8% WDG

with a linear ($P < 0.01$) decline in DMI as WDG was increased further (Figure 5). Both ADG and DM conversion responded quadratically ($P < 0.01$) to level of WDG with maximum ADG at 8% WDG and optimal DM conversion at 16% WDG.

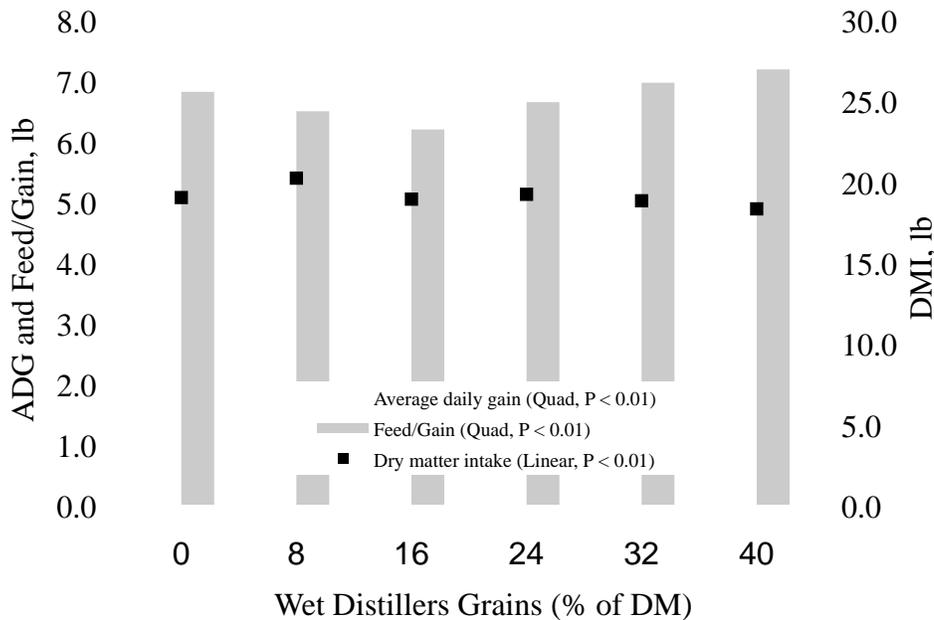
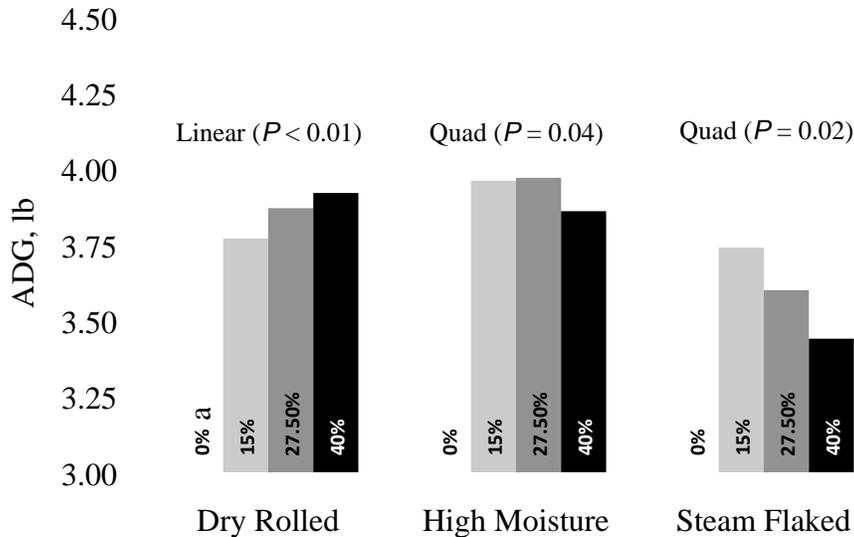


Figure 5. Effect of wet distillers grains added to steam flaked corn based finishing diets on heifer performance (Daubert et al., 2005). ADG, average daily gain; DMI, dry matter intake.

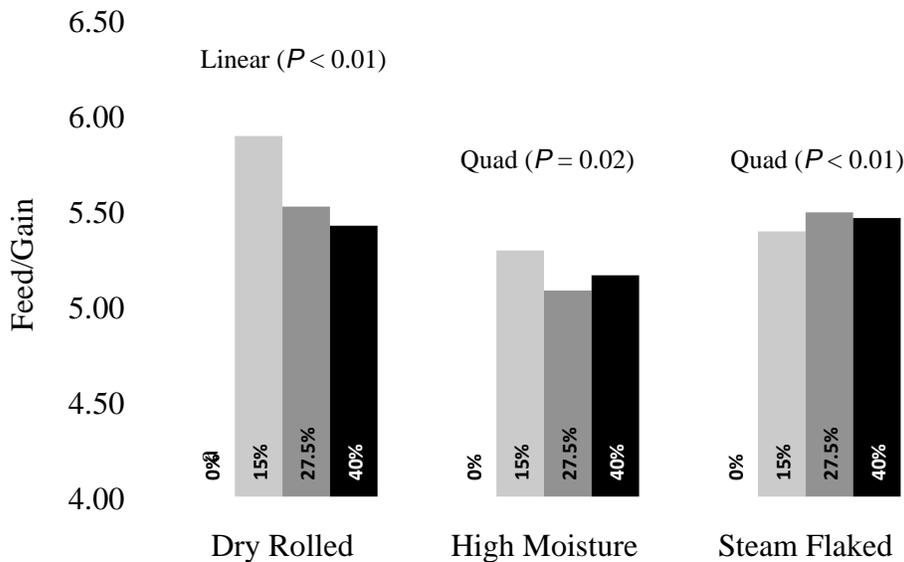
The data of Vander Pol et al. (2006) and Daubert et al. (2005) indicate that the optimum WDG grains inclusion level for performance is between 20% and 30% (DM basis) for DRC and HMC diets and between 10 to 15% of the dietary DM for SFC diets. These observations are supported further by results from a recent study by Corrigan et al. (2007) that evaluated 0, 15, 27.5, and 40% WDG (DM basis) in DRC, HMC and SFC diets. In this study, ADG and DM conversion responded linearly ($P < 0.01$) to

WDG level in DRC diets but quadratically ($P < 0.05$) in HMC and SFC diets (Figures 6 and 7). The optimum ADG and DM conversion was achieved at the 40, 27.5, and 15% WDG level for DRC, HMC and SFC diets, respectively; this clearly illustrates a level by grain processing interaction that is observed in feedyards. Note that these optimum levels are based solely on performance. Obviously the economically optimum inclusion level also depends on the price of the WDG relative to corn and protein supplement costs.



^aNumbers inside bars represent level of distillers grains (DM basis).

Figure 6. Effect of level of wet distillers grains in dry rolled corn, high moisture corn, and steam flaked corn diets on average daily gain (ADG) in finishing steers (Corrigan et al., 2007).



^aNumbers inside bars represent level of wet distillers grains (DM basis).

Figure 7. Effect of level of wet distillers grains in dry rolled corn, high moisture corn, and steam flaked corn diets on feed/gain in finishing steers (Corrigan et al., 2007).

Value of Corn Processing with Byproduct Diets

Wet Corn Gluten Feed. A portion of the performance response when WCGF is fed to finishing cattle has been attributed to a reduction in subacute acidosis (Krehbiel et al., 1995). This certainly agrees with the feedyard observations of increased DMI and a reduction in digestive disturbances when WCGF is included in finishing diets.

Scott et al. (2003) and Macken et al. (2006) each conducted trials with the hypothesis that if subacute acidosis is controlled by WCGF in the diet, then an

improvement in feed conversion should be observed when corn is processed more intensively to increase starch digestibility. In three trials, these authors fed 22 to 32% WCGF (DM basis) in DRC, HMC, and SFC-based diets. As hypothesized, DM conversion generally improved as the corn was more intensively processed (Figure 8). Processing intensity was ranked by fecal starch in these trials. Another interesting observation in the first trial of Scott et al. (2003) was the marked improvement in DM conversion between dry rolled corn as compared to whole corn in diets containing WCGF (Figure 8).

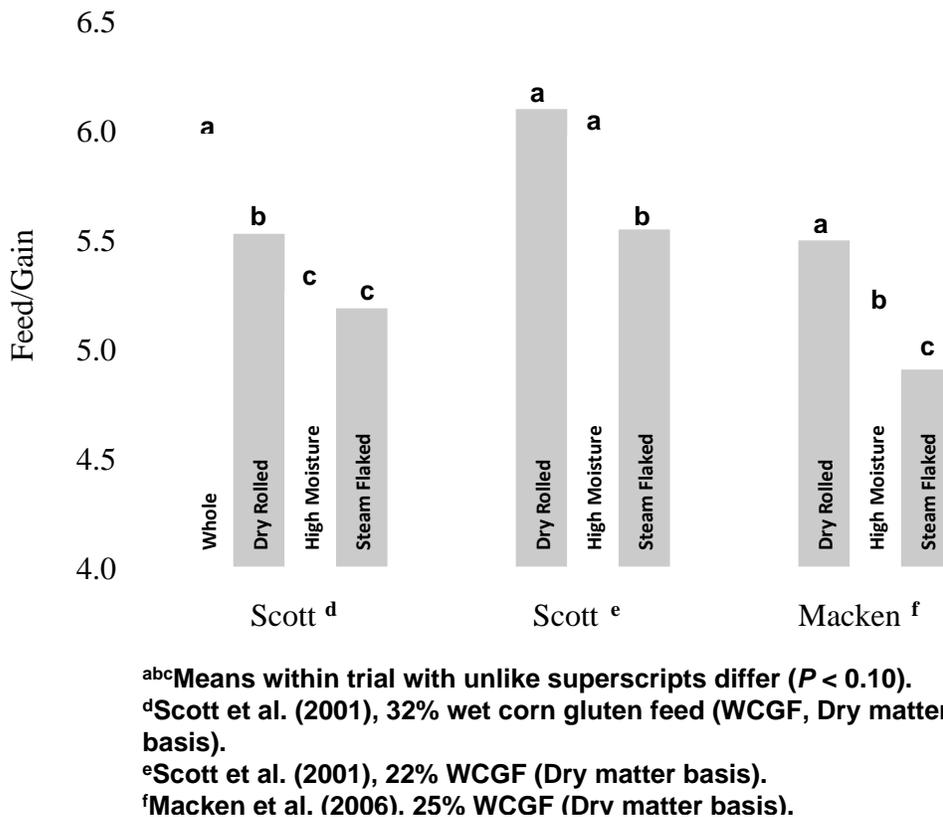


Figure 8. Effect of corn processing on feed/gain in diets containing wet corn gluten feed.

Wet Distillers Grains. We have noted that the corn processing response may be slightly different for WDG than for WCGF; this is supported by two recent feeding studies. Vander Pol et al. (2006) fed 30% WDG (DM basis) across various corn processing methods and observed no significant difference in DM conversion among the DRC, DRC/HMC, or SFC treatments (Figure 9).

The HMC treatment had a significantly improved ($P < 0.05$) DM conversion over the SFC

treatment, but DM conversion was not different for HMC than for the DRC or DRC/HMC treatments. Whole corn and fine ground corn had poorer ($P < 0.05$) DM conversions than all other processing methods. Note that only 30% WDG (DM basis) was fed in this trial and it was shown previously that there appears to be an interaction between WDG level and corn processing method. To illustrate this interaction more clearly, the data of Corrigan et al. (2007) are shown in Figure 10.

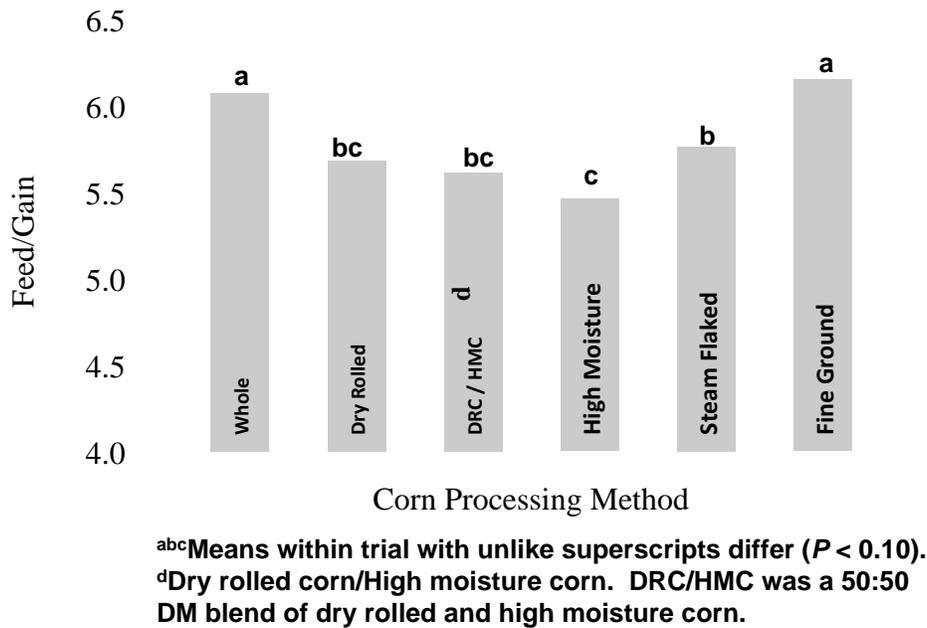


Figure 9. Effect of corn processing method on feed/gain of steers fed diets containing 30% (DM basis) wet distillers grains (Vander Pol et al., 2006).

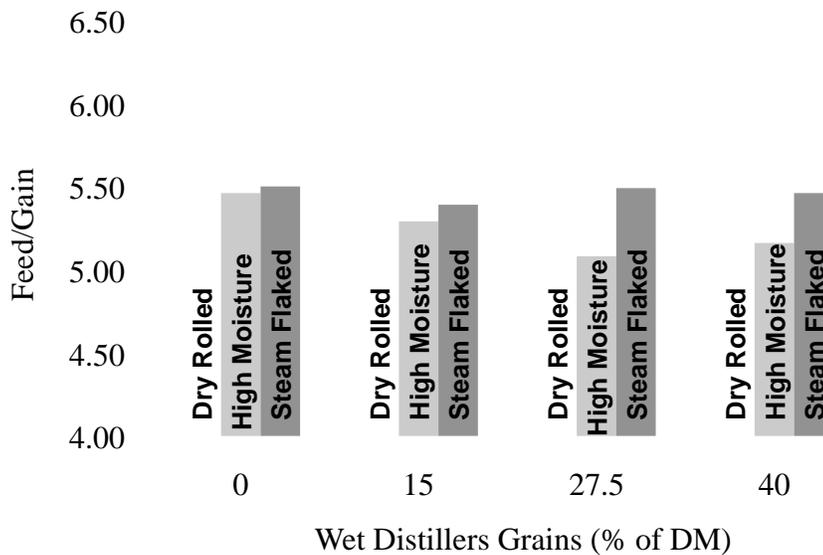


Figure 10. Effect of corn processing method on feed/gain in finishing steers fed various levels of wet distillers grains (Corrigan et al., 2007).

These are the same data as Figure 7, but the treatments have been rearranged and grouped by WDG level rather than by corn processing method. Statistics are not available for this figure because

treatments were not analyzed in this manner in the original report. However, this figure clearly illustrates the interaction between WDG level and corn processing method. Most interesting is the relative difference

between DRC and SFC as WDG level in the diet is increased. In the control diet, steam flaking produced a 10% improvement in DM conversion over dry rolling. With 15% WDG (DM basis) in the diet, the SFC advantage over dry rolled corn was reduced to 8.5%, and all treatments were essentially equal at 27.5% WDG. The treatment levels that most

accurately reflect our current feeding programs are the SFC diet with 15% WDG and the DRC diet with 27.5% WDG. Steam flaking still has an advantage in this comparison, but the advantage certainly is smaller than before WDG became a significant part of our feeding program.

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QUESTIONS AND ANSWERS

Q: For Rob or Andy, are the economics going to drive distillers' grains into the ration well above the level where performance is optimum? I was intrigued about the interaction between grain processing and distillers' grains. What will be the basis for deciding what level to feed if optimum performance is not the target?

A: Can we afford to give up performance and still get better cost of gain? We are at that point in several yards where distillers' grains are priced below the price of corn. We often think that we cannot afford to give up feed conversion but perhaps we should. As yet, we resist giving up efficiency, but if we owned the cattle, we would. The limitation for the custom cattle feeder is perception of their customers. Dry matter conversion, not the cost of gain, drives a customer's perception of the cattle and the feedlot. We currently are discussing how much efficiency we can give up to improve our cost of gain.

Q: Rob or Galen, is there any effect of high levels of co-products on carcass traits when cattle are harvested at a constant carcass weight or composition?

A: This is a popular question. You may have seen Certified Angus Beef white paper that shows a trend for less marbling of cattle fed distillers' grain. I think that Galen has data that shows that for cattle fed for a similar number of days on feed, marbling was not reduced. From a practical feeding standpoint, with rolled corn or high moisture corn diets where we had no fat in the diet without distillers' grains, we are increasing rate of

gain by half a pound per day by feeding distillers' grains, so we are feeding these cattle 20 fewer days. So is quality grade lower? Probably so. But with the same days on feed, we probably would not see that reduction in quality grade.

Erickson: The CAB paper forced us to look at quality grain effects on marbling. The meta-analysis we conducted was to look at quality grade effects. Our conclusion from that data was that feeding up to 40% of either corn distillers' grains or corn gluten feed did not negatively affect marbling score. Most of our studies feed cattle fed all diets for the same number of days; we are criticized if we don't. I would prefer to sell cattle at same end-point in all treatments if someone could show me how to predict that accurately across treatments. We feed the same number of days, so generally speaking, our cattle that are performing better, those that are fed by-products, are fatter at harvest. So with our cattle fed higher amounts of by-products tend to have equal or greater marbling. Alfredo Dicostanzo (Minnesota) with Dr. Reinhardt from Kansas State put together a summary of many additional experiments and concluded that feeding up to 35% does not negatively affect quality grade. If we were to feed higher levels, then what? We will be looking into that. Lots of interest. As an industry, we are seeing a depression in quality grades and marbling scores.

Additional Comment by Krehbiel: The correlation between the decrease in quality grade and the increase in distillers' probably is about the same as between quality grade and black hided cattle, isn't it?