THE CHANGING NATURE OF DAIRY RATIONS AND HOW IT AFFECTS FORAGE DEMAND

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INTRODUCTION

One of the major staples of dairy rations has been grain corn. In years past, a typical ration fed to a high producing cow in the San Joaquin Valley may have included up to 15 pounds of processed corn, at or slightly exceeding 25% of the total dry matter intake. The heavy use of corn as source of energy in dairy rations has mainly been due to its historically attractive prices and wide availability. In practical dairy nutrition, this has resulted in corn grain being used to maximize levels and amounts of fermentable carbohydrate that provides energy to both the rumen microbes and the dairy cow. Over the past two years, this feeding regimen has changed dramatically linked to record high corn prices, the increased availability of distiller's grain as an alternative feed ingredient, and more recently, the decision by a number of cooperatives and processors in the state of California to imposed caps on milk production.

Looking at each of these factors separately we note that earlier this year corn futures established a new all-time high at close to $8.00 per bushel and this resulted in spot rolled corn prices in California trading in excess of $320 per ton earlier this year. Though values have retrenched with spot futures seeing prices as of mid-October almost halved, down to $4.00 per bushel, they remain historically high. As shown in Figure 1, the increases in feed prices have contributed to dramatic increases in total feed costs for California dairy producers. In early 2007, feed costs as a percent of total cost of production was approximately 55% but in the first part of 2008, feed costs increased to nearly 60%.

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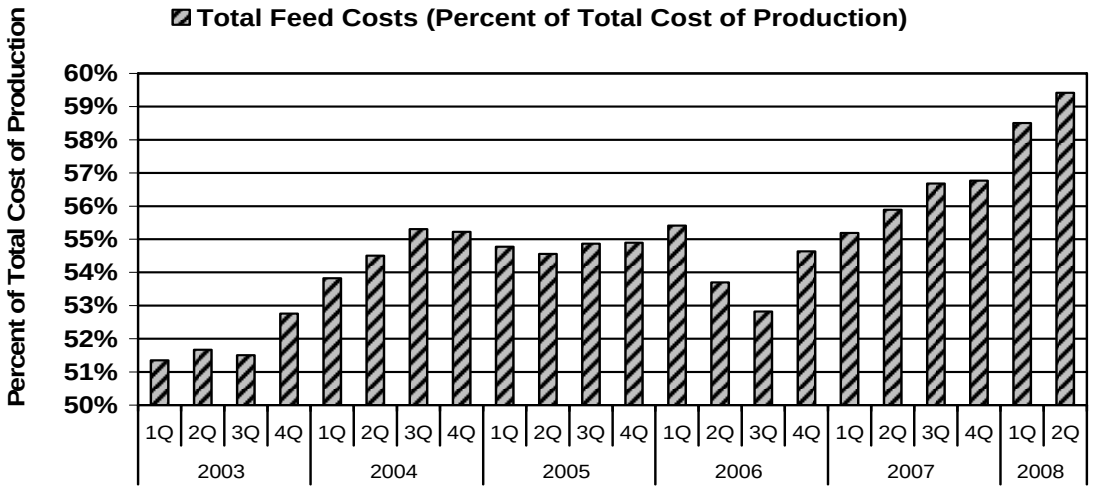
Figure 1. Total Feed Costs (Percent of total Cost of Production)
January 2003 through June 2008



Source: CDFA Dairy Marketing Branch

There are many reasons for the surge in corn prices over the past 2 ½ years but some of the main factors include;

For 25 years, grain prices were flat to lower providing little financial incentive to increase production via higher acreage or invest in research for higher yielding hybrids. Rise in world GDP growth especially in developing countries (China, India, Brazil, Russia) has translated into rising personal incomes with change in diet to one featuring increased consumption of meat and dairy protein. This necessitates more feed grains and protein meals to feed cattle, hogs, and poultry. For many reasons, big push for renewable fuels and this increases competition for bulk commodities. Steady depreciation of dollar has helped buoy prices for a number of commodities that are valued in greenbacks.

Of these factors, the one receiving the most attention from dairy producers has been the significant expansion of ethanol production with 95% of that manufactured from corn as the feedstock. Starting in 1970's, there was a need to develop alternative and renewable fuel sources in response to skyrocketing crude oil prices and this led to the first large scale expansion of ethanol for such purposes. The passage of The Clean Air Act of 1990 requiring use of oxygenated fuel for reformulated gasoline for utilization in areas where ozone problems existed gave a further boost to ethanol's prospects. The Energy Policy Act of 2005 established a renewable fuels standard (RFS) that mandated the use of ethanol and other renewable fuels in gasoline. The RFS requires use of 7.5 billion gallons of ethanol by year 2012. The latest development was the 2007 State of the

Union address which highlighted the need to reduce gasoline consumption by 20% over the next 10 years and to increase renewable and alternative fuels by up to 35 billion gallons which is at least five times the present mandate by the year 2017.

Since that time, ethanol has come under heavy criticism for a number of reasons. Foremost has been the huge escalation in food costs being blamed on high corn prices due to greater ethanol output. Meanwhile, recent publications in a number of scholarly journals refuted ethanol's status as being a "green" fuel. Needles to say, the livestock, dairy, and poultry industries have been in an uproar over the rise in what is their largest expenditure. In this election season, there has been increased scrutiny over Federal and state subsidy payments to the ethanol industry along with the onerous import tariff that prevents cheaper foreign product from coming into the U.S. Finally, talk of shifting feedstock from corn to other sources being blunted by reports that commercially feasible cellulosic ethanol production is still years away.

Figure 2. U.S. corn used in production of ethanol in million bushels and as % of production

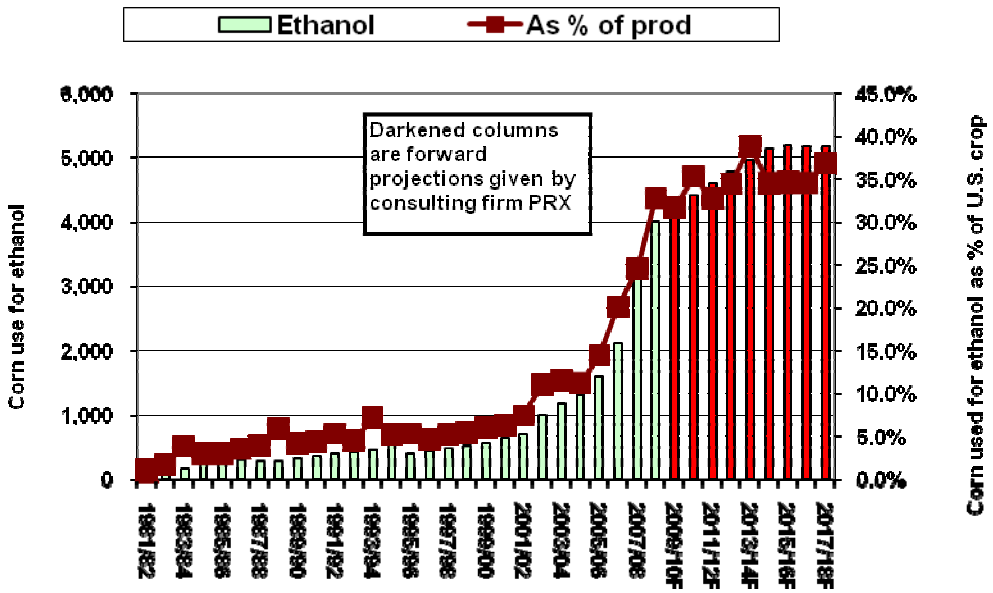


Figure 2 shows how explosive demand for corn has been by the ethanol sector. As recently as the 2004/05 season, total corn use by the industry was a little over 1.3 billion bushels, about 11.5% of total U.S. corn production. A mere four years later, corn use by the nation's ethanol firms has tripled to over 4.0 billion bushels and that will now account for 33% of total domestic corn output.

Alternative Ration Strategies

Some have erroneously equated the wide use of corn in dairy rations to a requirement for corn by the animals. This is incorrect both nutritionally and economically. As shown in Table 1, when barley was substituted for corn in lactating cow rations, none of the production, composition, intake, and feed efficiency parameters was affected significantly by the type of grain used.

Table 1. Effects of feeding corn or barley on milk production, composition, dry matter intake, and feed efficiency.

	DePeters and Taylor, 1985			Bilodeau et al., 1989		
	Corn	Barley	*P*	Corn	Barley	*P*
Yield (lb/d)						
Milk	61.6	54.8	n.s.	64.2	63.6	n.s
Fat	1.84	1.67	n.s.	-	-	n.s.
Protein	1.96	1.94	n.s.	-	-	n.s.
Composition (%)						
Fat	3.01	2.81	n.s.	3.98	3.96	n.s.
Protein	3.21	3.23	n.s.	3.36	3.34	n.s.
Dry matter intake (lb/d)	40.7	40.3	n.s.			
Gross Feed efficiency	1.51	1.50	-	1.33	1.31	-

According to St. Pierre and Knapp, 2008, many nutritional rules of thumb were derived during times when corn was an inexpensive feed ingredient. Some of these rules led to good working rations that were economically efficient with cheap corn.

Grains, like corn, are an excellent source of starch which is highly fermentable by ruminal microorganisms. This propionic acid produced by starch-fermenting bacteria is converted to glucose by the cow's liver; this glucose is used to make milk. In addition, the bacteria provide about 50 to 60% of the protein needs of the cow as they are washed

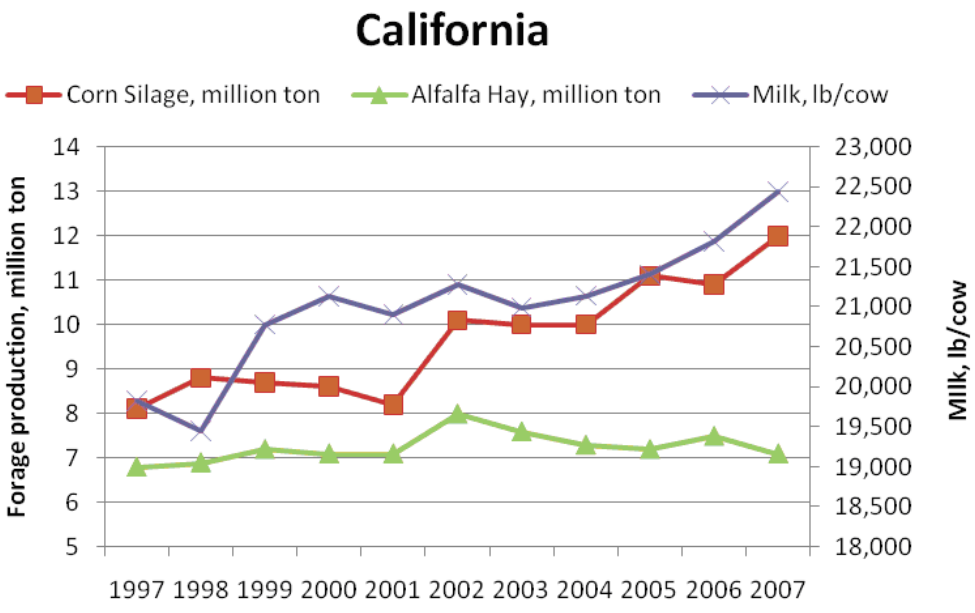
out of the rumen and are digested in the abomasums and small intestine. To optimize milk production, starch should make up 24 to 26% of the dietary dry matter.

With higher corn prices and subsequent increases in other grain prices strategies need to be implemented to reduce feed costs without disrupting the rumen environment such as with providing less starch for rumen fermentation. Among the strategies to reduce grain usage in dairy rations increasing forage inclusion, and the more extensive use of by-product feeds could be implemented.

Increasing Use of Forages in Dairy Rations.

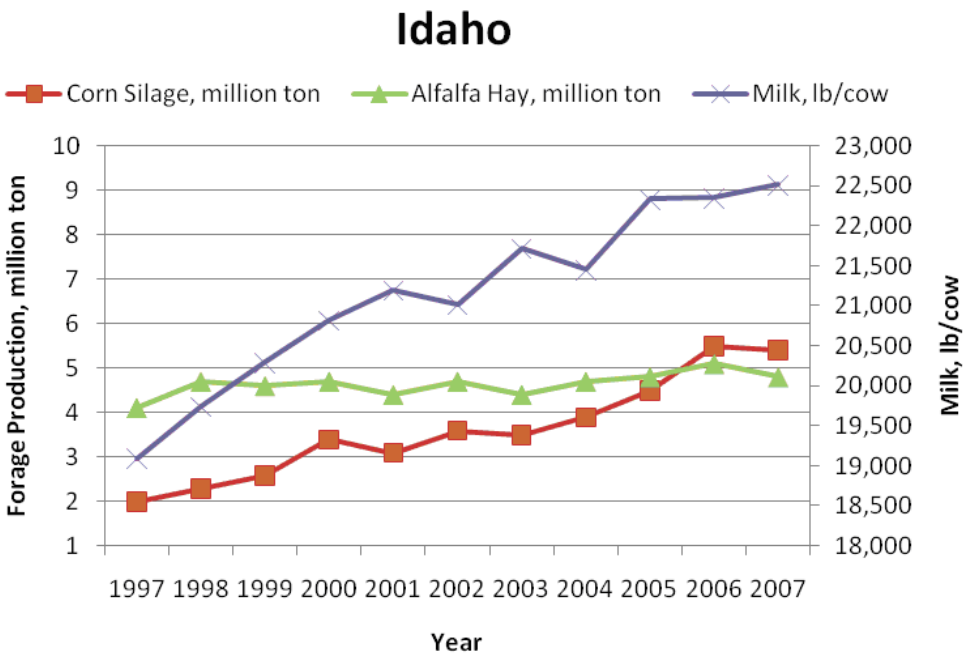
One alternative to feeding corn grain is to feed more corn silage and fewer legumes. Forages such as corn silage becomes a natural choice as the primary forage in rations where corn grain is partially removed. Corn silage is low in protein and provides fermentable starch, energy, and relative amounts of effective fiber (depending on its particle size). As grain prices have increased since the 2006 harvest, forage utilization has increased by 5-10% on a DM basis, often with little or no decrease in milk yield (Knapp, 2008). As shown in Figures 3 and 4, corn silage production has increased as compared to alfalfa hay when looking at the states of California and Idaho

Figure 3. Corn silage, alfalfa hay, and milk production for California.



NASS, 2008

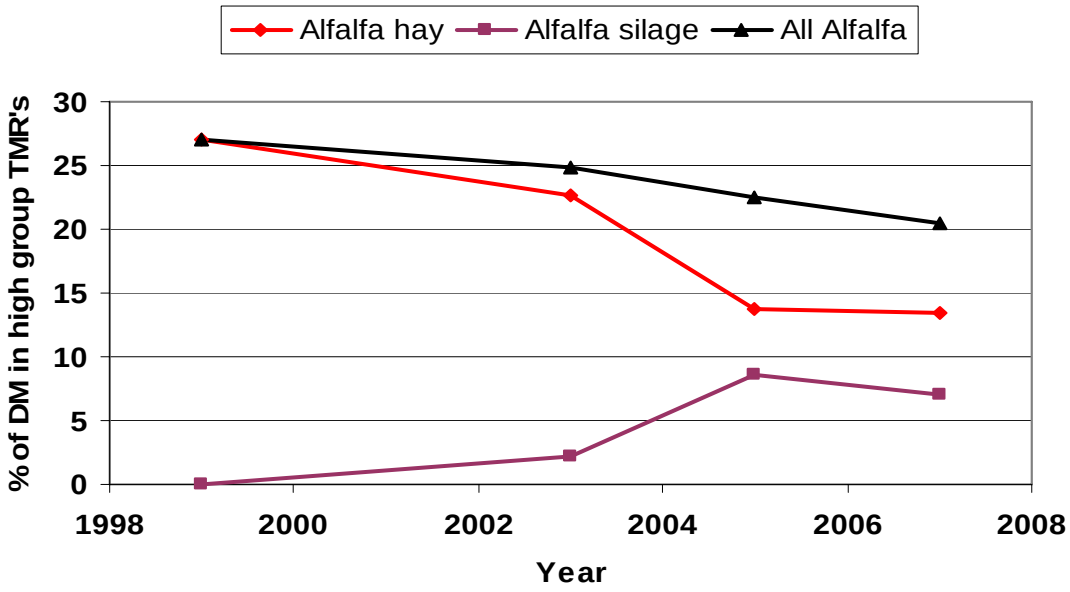
Figure 4. Corn silage, alfalfa hay, and milk production for Idaho.



NASS, 2008

The increase in corn silage feeding as it pertains to California dairy farms was also documented by Robinson, 2008. He conducted surveys of California dairy farms in 1999, 2003, 2005 and 2007 with regards to feeds being used in total mixed rations (TMR). Based on these surveys, alfalfa hay proportions of TMR have been dropping for over a decade in California, and it is only about 50% of what it was in 1999 (Figure 5), at about 13% of TMR DM. This has been buffered to some degree by increased use of alfalfa silage and fresh chop (which is included in 'alfalfa silage' in Figure 5), which is largely produced on-dairy as opposed to alfalfa hay which is extensively grown off-dairy by alfalfa dedicated hay growers.

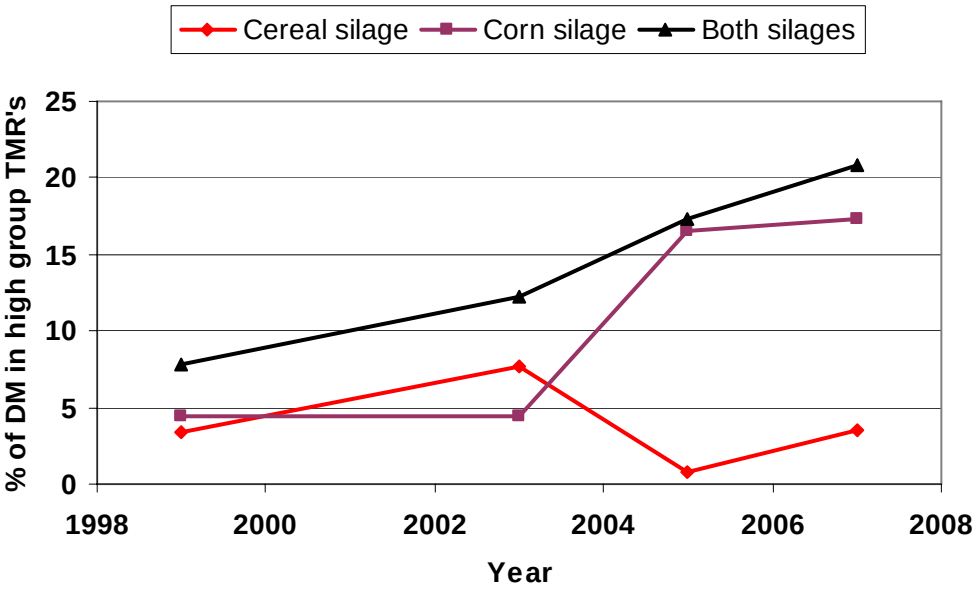
Figure 5. Use of alfalfa hay and silage.



Robinson, 2008

In contrast to alfalfa hay, use of corn silage has increased sharply (Figure 6) rising from about 5 to about 17% of TMR DM over this same period. Combined with cereal silage use, use of both corn and cereal silage has more than doubled, and was more than 20% of TMR DM in the 2007 survey of 16 dairies.

Figure 6. Use of corn and cereal silages.



Robinson, 2008

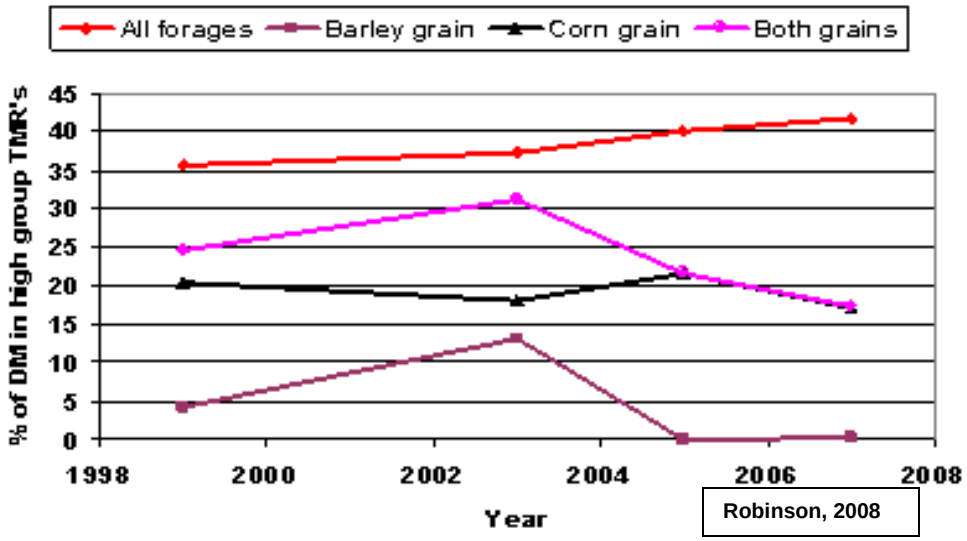
Increased production and use of corn silage is most likely influenced by a number of factors. For example, corn silage is harvested once per season rather than three or more cuttings, which simplifies harvesting and storage. With limited land base, corn silage also allows producers to harvest more tons of dry matter and TDN per acre than with legumes and grasses. Harvesting quality corn silage is less difficult than alfalfa, resulting in a more consistent feed ingredient. In contrast to alfalfa or grasses, corn silage contains both forage and grain and, therefore, provides a good source of fiber along with starch, which decreases the amount of grain required in the diet (Raeth-Knight et. al. 2007). Corn silage is also an excellent crop on which to apply manure pond water.

Data from the University of Minnesota (Allen, 2001) indicate the feeding higher corn silage diets will allow dairy producers to feed decreasing corn diets with excellent performance. Cows were fed diets ranging from 31 to 50% corn silage (DM basis) and 28 to 0% corn grain (DM basis). Alfalfa hay was constant at 15% of ration DM. All diets resulted in at least 90 lb milk/day and cows receiving diets without any corn produced approximately 100 lb milk/day. It is important to note, however, that cows were placed on their respective diet immediately after calving and as corn grain was decreased, additional fat was added to achieve an equal energy level to the corn diet.

Increased Use of By-Product Feeds

In the dairy feed survey previously mentioned by Robinson, 2007, both corn and barley levels have decreased in dairy rations over the last few years while forage levels have increased (Figure 7). As stated earlier, the cost of these grains has been a major determinant in their reduced usage.

Figure 7. TMR use of all forages as well as grains



With these reduced grain levels what are dairy producers using to replace the corn or barley that has been reduced or taken out completely. By-products from the ethanol industry have been utilized to some extent to replace these grains.

With every bushel of corn used in the ethanol process generating 17 pounds of distiller's grains (DG), one can see how production of this product has boomed. The production of distillers in the US increased ten-fold between the years of 1980 and 2000, increasing from 320,000 to 3.5 million metric tons (1 metric ton = 2205 pounds). Production doubled again between 2000 and 2004 to over 7.3 million metric tons and production doubled again between 2004 and 2008 to over 18 million metric tons produced. Current projections for 2008- 2009 are for 24 million metric tons of DG to be produced.

Kalcheur, 2005 conducted a meta-analysis of 24 studies in which wet or dried DG were fed to lactating cows. The results are summarized in Table 2. Diets with greater than 30% DG resulted in decreased intake, milk yield, and milk protein percent. However, the data indicated that DG can be fed up to 20% of the ration DM, about 10-12 lb/cow/day as fed, in lactating dairy cow diets without negatively impacting production.

Table 2. How much distillers grains (DG) can we feed?

N[1]	DG, (% of DM)	DMI, (lb/d)	Milk, (lb/d)	Fat (%)	Protein, (%)
29	0	48.9[b]	72.8[ab]	3.39	2.95[a]
13	4 to 10	52.2[a]	73.6[a]	3.43	2.96[a]
34	10 to 20	51.6[ab]	73.2[ab]	3.41	2.94[a]
15	20 to 30	50.3[ab]	73.9[a]	3.33	2.97[a]
7	>30	46.1[c]	71.0[b]	3.47	2.82[b]

Kalcheur et al., 2005

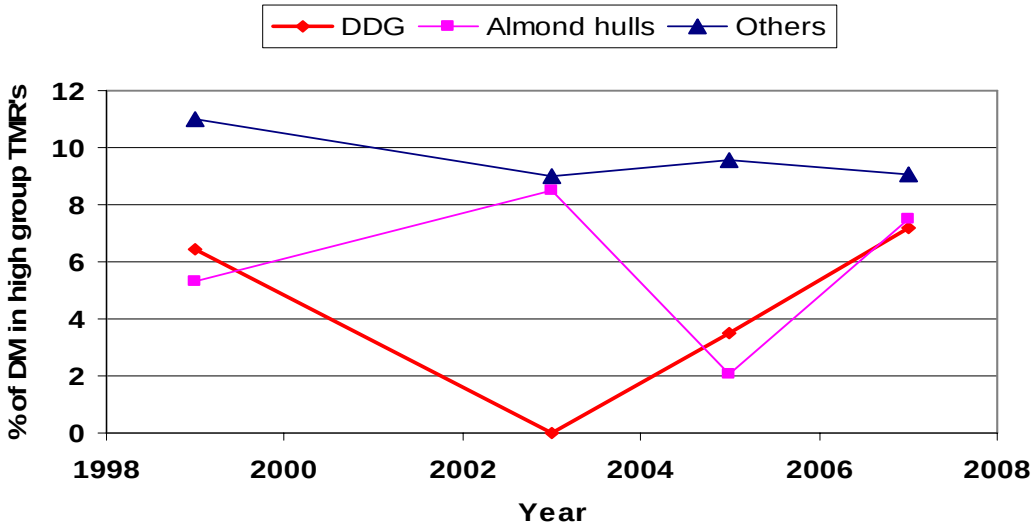
[1]n = # of treatment included in meta-analysis (24 total studies)
[ab]Means in columns with different superscripts differ ($P<0.05$)

Even though DG maybe fed at 20% of the diet DM, most producers stay at 10% of the ration or lower. According to Raeth-Knight et al., 2007, recommendations on the feeding of DG include the following:

- The nutrient composition of wet and dried DG can be quite variable. If you are going to feed
  10% or more of the ration as DG, know your source and nutrient quality guarantees.
- Wet DG in high corn silage or other fermented forage rations may result in rations being too wet,
  which could limit DM intake.
- DG and corn have similar energy values, but the energy in DG is from fat and in corn it is from
  starch. Substituting DG for corn grain will lower starch levels in the ration and may decrease milk production.
- Fiber from distillers is not 'effective' at promoting cud chewing or maintaining rumen function.
  Fiber from forage must be maintained in rations.
- High oil diets can depress milk fat tests, especially with the use of Rumensin.
- Lysine levels in corn products are low and therefore, lysine may be limiting in some DG diets.
- The high phosphorous content of DG may affect crop nutrient management plans.

In the dairy feed survey of California dairies previously mentioned by Robinson, 2008, the use of DG has risen sharply as shown in Figure 8. The use of DG will undoubtedly continue in dairy rations as long as the supply is plentiful and the price is competitive. The challenge for dairy nutritionists in the use of DG will be overcoming the limitations of incorporating high levels of this product into dairy rations due to favorable pricing.

Figure 8. TMR use of DDG, almond hulls and other by-products.



Robinson, 2008

SUMMARY

The search for renewable fuels has increased the growth of ethanol plants across the U. S. and has increased the demand for corn grain. Prices for corn grain have become historically high which has led many dairy producers and nutritionists to question levels traditionally fed. Many dairy producers have reduced corn inclusion in rations for lactating dairy cows by 25 to 35% by increasing forage and by-product utilization without sacrificing milk yield or milk components. If this is going to be successful, forage quality needs to be maximized. Use of by-products such as distiller's grain has been utilized to some extent in replacing some of the corn grain in dairy rations. Given historically high prices for corn grain and cottonseed, the future of dairy rations will probably consist of higher inclusions of higher quality forages and by-products from the ethanol industry.

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