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Animal Sciences

Issues Surrounding the Use of Distillers' Grains by the Indiana Dairy Industry

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Overview

The rapid emergence of ethanol plants in Indiana will result in a large quantity of corn co-products that could be utilized to feed dairy cattle and heifers. While distillers' grains **(DG)** are being fed in Indiana, much of the product is fed as dried distillers grains with solubles **(DDGS)**. However, the quantity that may be fed as a percentage of ration dry matter is limited. Clearly, if the commodity price falls below the breakeven price, the growing Indiana dairy industry may be able to utilize a sizable quantity of wet DG. However, there are numerous issues that will affect the utilization of DG, either wet or dry.

Dairy Industry Overview

Since 1998, the Indiana dairy industry has grown, partially due to expansion of existing dairy herds, but mainly because of the construction of large modern dairy farms by producers relocating from other states or countries. Table 1 has the growth of Indiana's dairy industry since 1997. While farm numbers have declined, milk production has increased dramatically (+36.8%) from more cows (+11.4%), larger farms (+80.1%), and better production per cow (24.3%). During this time, Indiana's rank in milk production per cow has increased from 21st to 10th, and total milk production from 18th to 14th.

Table 1. Change in herds, cows, heifers, and milk production from 1997 to 2005.

	1997	2000	2005	Percent Change 1997-2005
Grade A Herds[1]	1875	1668	1435	-23.5%
Grade B Herds[1]	1104	786	399	-63.9%
Total Herds[1]	2979	2454	1834	-38.4%
Average Herd Size	47	60	85	+80.1%
Milking Cows[2] (1,000s)	140	148	156	+11.4%
Replacement Heifers[2] (1,000s)	70	60	56	-20.0%
Total Milk Production[2] (million lbs.)	2189	2365	2995[3]	+36.8%
Milk Production per cow[2] (lbs. /mo.)	1380	1400	1715	+24.3%

[1] Source: Indiana Board of Animal Health Dairy Program.
[2] Replacement heifers >500 lbs. Source: Indiana Agricultural Statistics Service.
[3] Production estimate for 2005 is 101.1% of 2004 production.

Geographical location of cow numbers by county for 1987 and 2002 are in Figure 1. Clearly there is now a concentration of dairy production in northwestern Indiana. This represents a shift from the concentration of dairy cows and dairy production in northeastern Indiana and may have implications for the feasibility of transporting wet DG to dairy farms.

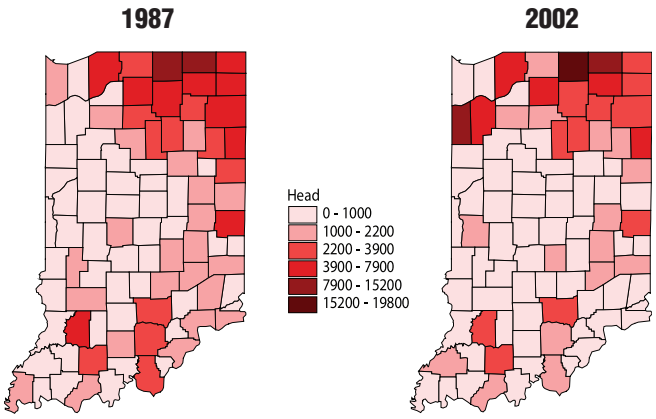

Figure 1. Shift in dairy cows from 1987 to 2002 (source: Tyler Mark and Alan Gray, Purdue University Department of Agricultural Economics).

The Indiana Board of Animal Health reports that they are currently evaluating dairy farm plans which will represent an increase of approximately 20,000 cows. At higher levels of production common on newly constructed farms, expansion of approximately 11,000 cows per year would allow doubling of milk production compared to 1997 by 2010. Continued improvement of milk production per cow will further increase total milk production on existing farms or offset lost production from farms that exit the industry.

Number of 500-pound dairy replacement heifers in Indiana has declined (-20.0%) since 1997 (Table 1 and Figure 2). However, the number of dairy calves less than 500 lbs. is not routinely reported, but this number is more likely to have tracked proportionally to the increased cow numbers. Many calves are shipped to other states at weaning or breeding age. There exists great potential for heifer development in many areas of Indiana and availability of DG may enhance the viability of heifer rearing in the state.

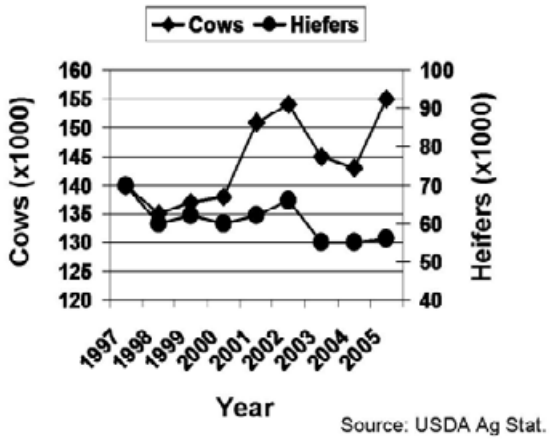

Figure 2. Annual numbers of dairy cows and 500 lb. replacement dairy heifers in Indiana from 1997 to 2005.

Potential for Utilization of DDGS by Dairy Cows and Heifers

The following includes rough estimates for using DG to feed replacement heifers in Indiana if fed at maximal levels in every herd. These expectations are, of course, unrealistic under present conditions. Nonetheless, they provide some indication of the maximum amount of DDGS that the industry could expect to utilize in Indiana under present knowledge of feeding the dry or wet product.

Cows

- Currently, there are 155,000 dairy cows in Indiana.
- Assume that dairy cows are lactating 305 days and are dry 60 days per year.
- Assume that the average dry matter intake **(DMI)** of each lactating cow is 50 lbs.
- Further, assume that as much as 20% of ration dry matter **(DM)** for lactating cows can be from DDGS without negative consequences on production (e.g. Schingoethe, 2004).
- Assume DDGS are about 90% DM.
- Indiana dairy cows could consume roughly 263,000 tons of DDGS per year
- Indiana's production of DDGS from the seven expected bioethanol plants is anticipated to be 1.4 million tons (Klein Ileleji, Personal Communication).
- Lactating dairy cows could use 19% of anticipated Indiana production of DDGS.

This calculation ignores dry cows, but DMI as well as the energy and protein requirements of dry cows decrease the amount of DDGS that could be fed to them. Many farms in Indiana do not achieve 50 lbs. of DMI per cow per day. Note that the figures above are calculated on a DM basis, such that the percentage of utilization would be unaltered if the DG are fed as wet or dried. The addition of wet DG in rations may be beneficial in adding moisture to the total mixed ration **(TMR)**, which could enhance palatability and reduce sorting of feed by cows.

Heifers

- In 1997, there were around half as many dairy replacement heifers as there were lactating cows. At that percentage of 500 lb. replacement heifers relative to dairy cows, Indiana would have 77,500 dairy replacement heifers > 500 lbs, if all such heifers were kept in the state.
- Assume average DM intake for an 800 lb. heifer to be 14.8 lbs per day. The value of 800 lbs. represents an average weight for replacement heifers > 500 lbs. that have not yet calved.
- Assume that for heifers, 30% of ration DM can be DG (Kalscheur and Garcia, 2004).
- Assume DDGS is about 90% dry matter.
- Indiana dairy heifers could consume roughly 70,000 tons of DDGS per year.
- Indiana's production of DDGS from the seven expected bioethanol plants is anticipated to be 1.4 million tons (Klein Ileleji, Personal Communication).
- Indiana dairy heifers could use ~5% of expected IN production of DDGS, if all heifers are retained.

Again some assumptions are necessary; and this calculation presents a maximum amount of DDGS (or its equivalent) utilization.

Not all dairy farms would even consider feeding DG for reasons described below. The issue of high levels of phosphorus and implications for land application of manure are among the major issues that need to be addressed.

Issues to be Addressed

Whether large amounts of DG as wet or dry co-products can be fed on dairy farms depends upon how well the ethanol industry can overcome the four main obstacles in feeding distillers grains to dairy cows.

These include:

1. **Inconsistency of the final product.**
   - The DDGS drying process often results in heat damaged proteins, thus DG are feared to be quite variable in their quality and composition. Plant to plant variation tends to be larger than within plant variation, but there is still variability and heat damage to proteins in the final product as a result of the drying processes, and the inconsistency in the quantity of distillers' solubles being added back to the grains before drying. (Kalcheur 2005, Personal communications).
   - There is concern about what happens to the feed value and consistency of the wet or dry DG in dairy rations if solubles are reduced or not added, as well as what other uses may be avenues for disposal or preferably utilization of the solubles.
   - Could additives be utilized to reduce spoilage of the wet DG or to reduce the amount of drying needed for DDGS? To reduce spoilage of wet DG, plastic sheets and sectioned automobile tires can be used for covering wet DG in concrete bunkers. However, not all farms would feed an adequate amount each day to allow enough product removal from the face of the bunker to prevent spoilage. Six ft. diameter silo bags have also been used to limit air penetration of wet DG. The use of larger silo bags is limited by the bulk density of the product that may rupture the bags after filling (Kalcheur and Schingoethe, 2004). Addition of organic acids such as proprionic acid has also been the subject of research at South Dakota State University and elsewhere. Cost of these methods will determine their use.
   - Are there feed safety risks of feeding wet DG or DDGS? Wet DG may develop areas of spoilage, with increased risks of mycotoxins from molds. Aflatoxins, zearalenone (F-2 toxin), and deoxynivalenol (vomitoxin) are the most common. Aflatoxins are especially able to withstand elevated temperatures such as those encountered by drying, and are therefore are a concern even with DDGS.
2. **High oil content that can depress milk butterfat content.**
   - De-germing of corn prior to ethanol production can reduce the unsaturated oil content of the wet DG or DDGS.
   - The interactions of levels of effective fiber with DDGS in the ration play a critical role in milk fat depression. This interaction needs more study.
   - We do not know the relative effect of wet versus dried DG on milk fat depression.
   - Negative consequences of the added vegetable oil from DDGS may be exacerbated by use of Rumensin for enhanced feed efficiency.
3. **Lower lysine levels than soybean meal.**
   - What are the consequences on amino acid balance of ruminant rations when feeding high levels of DG or DDGS? Feeding of proteins from corn to rapidly growing young stock or to lactating

dairy cows provides a poor profile of amino acids compared to animal requirements for growth or lactation. Lysine in particular is a concern when rations are composed primarily of corn protein sources. Therefore, replacing soybean protein with corn protein from DG creates challenges for nutritionists to supply adequate lysine to meet needs for growth and lactation.

- The appropriate combinations of DG and other forages and concentrates to be fed to meet the amino acid profile needs to be determined.

4. **Crop nutrient management problems arising from high levels of phosphorus and potential overfeeding of protein. There are numerous questions related to this issue:**
   - Could de-germed corn provide a lower level of phosphorus in the product?
   - What are the relative portions of phosphorus, protein, individual amino acids, and energy arising from the germ and remainder of the corn?
   - Are there manure management practices that could reduce the amount of Phosphorus in manure? Frequently, the phosphorus content of dairy manure is highest in the fine solids portion, rendering solids separation relatively ineffective in removing phosphorus. Allowing fine particles to settle out of manure and decanting liquid to storage may be somewhat effective in concentrating phosphorus to allow targeted land application. Additionally, flocculation by addition of Alum or other products followed by separation (as is done with human sewage) can work; though costs may be prohibitive.
   - What is the availability of Phosphorus from wet DG or DDGS relative to forage sources? This has not been well studied in ruminants. In Dairy NRC, 2001 forages are assumed to have a phosphorus absorption coefficient (AC) of 64%, while the coefficent in all concentrates is assumed to be 70% (AC).
   - Which forage combinations work best with DG to balance protein and phosphorus needs of the lactating dairy cows or heifers?
   - The undesired consequence of variable plant-to-plant and batch-to-batch protein quality, the poor quality of the amino acid profile in distillers grain protein, and it's relatively low cost compared to 48% CP SBM may result in excessive nitrogen (in urine) and Phosphorus (in feces) of cows supplemented with these corn distillers feeds.

Other Issues

In addition, there are other emerging issues relative to utilization of wet DG or DDGS. For example, excellent feed quality may be obtained by ensiling wet DG with chopped corn stocks or straw. However, this only utilizes product at the time of corn harvest. Corn stalks could be dried and stored for later ensiling with wet DG, but that would require additional handling which may be too expensive for a relatively low value feed component. Are there other alternatives for storage of wet DG? Upright and bunker silos would prove difficult to use because of the limited amount of feed removal per day. As stated previously, success has been obtained with silage bags, but bags may rupture due to the weight of the product relative to the forages for which the bags are designed. Daily or frequent delivery of wet product directly from the plant may be a better system, but economics of how far the deliveries may be made must be determined.

Finally, it will be necessary to know the breakeven price for feeding wet DG or DDGS. How will the breakeven price be affected by the corn price? What other implications will rising corn prices have on the least-cost rations for lactating, dry, and close-up cows and dairy replacement heifers.

Further Reading

1. Scientific Articles

Birkelo, C.P., M.J. Brouk, and D.J. Schingoethe. 2004. The energy content of wet corn distillers grins for lactating dairy cows. *J. Dairy Sci.* 87:1815-1819.

Liu, C., D.J. Schingoethe, and G.A. Stegeman. 2000. Corn distillers grains versus a blend of protein supplements with or without ruminally protected amino acids for lactating cows. *J. Dairy Sci.* 83:2075–2084.

Schingoethe, D.J., M.J. Brouk, and C.P. Birkelo. 1999. Milk production and composition from cows fed wet corn distillers grains. *J. Dairy Sci.* 82:574-580.

Nichols, J.R., D.J. Schingoethe, H.A. Maiga, M.J. Brouk, and M.S. Piepenbrink. 1998. Evaluation of corn distillers grains and ruminally protected lysine and methionine for lactating dairy cows. *J. Dairy Sci.* 81:482-491.

Powers, W. J., H. H. van horn, B. Harris, Jr., and C. J. Wilcox. 1995. Effects of variable sources of distillers dried grains plus solubles on milk yield and composition. *J. Dairy Sci.* 78: 388-396.

Martz, F.A., R.T. Belo, M.F. Weiss, R.L. Belyea and J.P. Goff, 1990. True absorption of calcium and Phosphorus from alfalfa and corn silage when fed to lactating dairy cows. *J. Dairy Sci.* 73:1288-1295.

2. Technical Bulletins

Kalscheur, K.F. and A.D. Garcia. 2004. Use of by-products in growing dairy heifer diets. SDSU Extension Extra. ExEx 4030, June 2004. *Dairy Science.*

Garcia, A.D. and K.F. Kalscheur. 2004. Ensiling wet distillers grains with other feeds. SDSU Extension Extra. ExEx 4029, May 2004. *Dairy Science.*

A. Garcia and G. Taylor. 2002. Economics of feeding distillers grains to dairy cows. SDSU Extension Extra. ExEx 4025, September 2002. *Dairy Science.*

Schingoethe, D.J., K.F. Kalscheur, and A.D. Garcia. 2002. Distillers grains for dairy cattle. SDSU Extension Extra. ExEx 4022, August 2002. *Dairy Science.*

3. Conference Proceedings

Garcia, A.D. 2005. Preservation and feeding of wet distillers grains to dairy cattle. 66th MN Nutrition Conference, St. Paul, MN. September 20-21, 2005.

Schingoethe, D.J. 2004. Corn coproducts for cattle. Proc. 40th Eastern Nutr. Conf., Ottawa, Ontario, Canada. May 11-12, 2004. pp. 30-47.

Schingoethe, D.J. 2004. Distillers grains for dairy cattle. Presented at Iowa Regional Distillers Grains Workshops, Calmar, Waverly, and Cherokee, IA. February 2004.

Klopfenstein, T. and R. Grant. 2001. Uses of corn coproducts in beef and dairy rations. Presented at the Minnesota Corn Growers Association Technical Symposium, Bloomington, MN. September 11, 2002.

Schingoethe, D.J. 2001. Using distillers grains in the dairy ration. Presented at the National Corn Growers Association Ethanol CO-products Workshop, Lincoln, NE. November 7, 2001.

Schingoethe, D.J. 2001. Feeding wet distillers grains to dairy cattle. Presented at the Distillers Grains Technology Council, 5th Annual Symposium, Louisville, KY. May 23-24, 2001.

Akayezu, J-M., J.G. Linn, S.R. Harty, and J.M. Cassady. 1998. Use of distillers grains and CO-products in ruminant diets. Presented at the 59th Minnesota Nutrition Conference, Bloomington, MN. September 1998.

Linn, J.G. and L. Chase. 1996. Using distillers grains in dairy cattle rations. Proc., Professional Dairy Management Conference, Dubuque, IA.

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