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Cottonseed Products and Natural Service Bulls

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A common recommendation is to limit whole cottonseed in dairy cattle rations to less than 12 % of the total mixed ration dry matter, and less than 8 lbs (as fed) per cow per day. It has generally been thought that adherence to this recommendation allows for the use of whole cottonseed in lactating dairy cattle rations, while safely avoiding the potential negative effect of gossypol, a toxic compound found in cottonseed products, on health and fertility. Unfortunately, conflicting results have been published regarding cottonseed products and bull fertility, bringing the relevance of the recommended feeding level into question. This is especially relevant in herds where natural service dairy bulls are housed with lactating cows and have access to rations containing cottonseed products.

Gossypol is a toxic compound found within pigment glands of the cotton plant. Gossypol can be found in two forms, either free or bound (attached to a protein). The bound form of gossypol is less toxic than the free form. In addition, gossypol exists naturally as a mixture of two stereoisomers called (+) gossypol and (-) gossypol, with (-) gossypol being more toxic.

Whole cottonseed may contain 0.01% to 1.7% free gossypol. The gossypol content of cottonseed products varies according to 1) the variety of cotton, with Pima cottonseed having a higher free gossypol content and a higher percentage of (-) gossypol than does Upland cottonseed, 2) conditions of the growing season (temperature and rainfall), and 3) oil extraction method. Following ginning to produce cotton lint for the textile industry, whole cottonseeds may be utilized in cattle rations, or may be dehulled and further processed to extract oil. There are two oil extraction methods, mechanical and solvent. The mechanical method allows for the extraction of oil, but does not rupture the pigment glands. In contrast, the solvent method ruptures the pigment glands, allowing for the release of gossypol. Historically, cottonseed meal made following oil extraction by the mechanical method contained less gossypol than cottonseed meal produced after solvent extraction. Recent advances in processing have shown if an expander is used in the solvent method, the gossypol content of cottonseed meal can be reduced.

Young calves readily absorb free gossypol, leading to gossypol poisoning. Clinical signs of gossypol poisoning include weakness, anorexia, poor growth, a distended abdomen, diarrhea, convulsions, and death. In contrast, healthy, mature ruminants are able to detoxify free gossypol through binding with proteins in the rumen. Nevertheless, free gossypol intake may overload this mechanism, leading to illness in mature ruminants. Furthermore, the rate of digesta passage may also contribute to illness in mature ruminants as cattle on high concentrate rations have a faster rate of passage that may permit gossypol to pass through the rumen unbound. Cattle ingesting high levels of gossypol may exhibit many of the clinical signs of gossypol poisoning previously mentioned.

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Some Implications of Changes in Federal Milk Marketing Order Milk Pricing: April 2003

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Periodically, changes are made in the formulas used to price milk sold in the federal milk marketing orders. These changes are made to reflect technology and other factors that affect the product value of milk produced at the farm. The most recent change occurred in April 2003 (details of the changes may be reviewed at the following web site: http://www.ams.usda.gov/dyfmos/mib/price_form_2003.htm).

The changes made in April basically place greater emphasis on protein and less on butterfat. These changes will affect most dairy farmers "bottom line" to some degree and the impacts will vary for each producer because all dairies do not produce the same quantity or quality of milk. In order to show an example of how the changes will affect farmer prices, production information for an average Jersey and Holstein herd will be used. The data are based on Jersey and Holstein herd averages for October 2002 as reported in the Rocky Mountain DHIA Annual Summary. Rocky Mountain DHIA affiliated dairies involve producers in Utah, Montana, and parts of southeast Idaho. The general characteristics used in the following analysis are shown in Table 1.

Table 1. Average production, by breed, for Rocky Mountain DHIA herds

	Jersey	Holstein
Pounds milk produced	15,480	22,674
Percent milk fat	4.44%	3.53%
Percent milk protein	3.62%	3.05%

An additional factor not included in the DHIA data, but needed for the calculations, is the percent "other solids". The data used in this analysis was 5.73% for Jerseys and 5.76% for Holsteins and came from bulk tank averages of commercial dairies in Utah. These four factors are the primary variables that affect the amount most producers receive for milk produced (PPD, hauling, and quality bonuses were not included in this analysis).

Product prices (price of cheese, butter, NFDM and whey) are the primary variables used to determine milk prices in the federal orders. As a result, changes in these prices have a direct effect on the price of milk received by farmers. For our example, two sets of product prices were used in this analysis (Table 2). These prices reflect the market prices for the primary products near the first of July for 2001 and 2003.

Table 2. Product prices ($ per pound) for July of 2001 and 2003.

	2001	2003
Price of butter	$ 1.99	$ 1.12
Price of cheese	$ 1.65	$ 1.42
Price of NFDM	$ 0.84	$ 1.03
Price of dry whey	$ 0.15	$ 0.18

(Please continue on page 3, under Milk Pricing)

(Milk Pricing, continued from page 2)

The values in Tables 1 and 2 were then used to determine the gross revenue that a dairy farmer would have received for milk produced under the old pricing system (pre-April 2003) and new pricing system (post April 2003) and are shown in Table 3. The calculations also looked at the pricing systems under high (2001) and low milk product prices (2003). These data show several important points. First, when product prices are low, like they have been in the last year and a half, the new formula results in a slight decline in gross revenue per cow for the average Holstein ($ -12.75) and Jersey ($ -7.74) compared with the old formula. This suggests that implementation of the new formula in April 2003 resulted in a slightly smaller check for most producers than had the old formula been retained. Both breeds lost money under the new formulas relative to the old formulas, but under these conditions, Jersey's had a $5 per cow advantage over Holsteins.

This impact would have been opposite had high product prices existed. In this case, the average Holstein and Jersey producer would have benefited from the change to the new formula—an gain of $117 for Holsteins and $97 for Jerseys over the old formula. Under these conditions, there was a $20 advantage for the Holsteins; primarily due to volume differences. This suggests that if recent improvements in product prices continue, producers will probably benefit from more income under the new formula relative to what would have occurred had the old formulas been retained. These two factors suggests that the new formula resulted in lower revenue in our current price situation compared with the old formula, but the benefits in the future are likely to be greater.

The third implication of the change in the formula deals with the differential impact of breed. As mentioned above, the decline for an average Jersey herd ($ -7.74 per cow) was not as great as it was for Holstein producers ($ -12.75 per cow) when the new formula is used and low prices exist. However, when product prices increase, the expected gain for Holstein cows is higher ($ 117.28) relative to Jersey cows ($ 97.00). This strongly suggests that producers need to monitor component production to a greater degree than they might have done in the past, especially now that protein production has a larger impact on milk prices under the new formula than existed before April 2003. However, care must be exercised in trying to increase component levels because milk volume is still a driving force in these formulas and efforts to increase protein and fat percentages has to weighed against the possible (probable) decrease in volume. This represents a tradeoff that each producer will need to carefully evaluate. It also represents a problem without a simple solution.

Table 3. Gross revenue for an average Jersey and Holstein cow under old (before April 2003) and new milk pricing formulas. Product prices were from 2001 and 2003.

	Holstein	Jersey
Old formula (2003 product prices)	$ 3,034.79	$ 2,484.65
New formula (2003 product prices)	3,022.03	2,476.91
Difference	$ -12.75	$ -7.74
Old formula (2001 product prices)	$ 3,543.49	$ 2,932.30
New formula (2001 product prices)	3,660.76	3029.29
Difference	$ 117.28	$ 96.99

(Cottonseed, continued from page 1)

Cows appear to be relatively resistant to reproductive effects of gossypol ingestion when fed according to recommended standards. Bulls, however, may be severely affected by gossypol intake. Brahman bulls fed a ration including 2.75 kg of cottonseed meal (8.2 g of free gossypol per day) exhibited a lower percentage of normal sperm compared with controls (49% vs. 83%) by week five of the study. Beginning with week three, treated bulls exhibited an increased proportion of sperm midpiece abnormalities in ejaculates. By week nine, depressed sperm motility was evident in treated bulls. Similar sperm midpiece abnormalities have been reported in gossypol-treated rats, hamsters, and monkeys, giving evidence that this abnormality appears to be specific to gossypol.

In contrast, Hereford bulls fed a ration containing whole cottonseed to provide 7.6 to 19.8 g of free gossypol daily exhibited no significant sperm abnormalities. The authors theorize the mineral content of the drinking water may have allowed for mineral binding of free gossypol, which would explain the lack of an effect of gossypol intake on sperm morphology in their study.

The effect of gossypol on bull fertility is controversial. For breeding bulls, the recommended free gossypol intake is 200 mg/kg for rations containing cottonseed meal and 900 mg/kg for rations containing whole cottonseed. A mature dairy bull fed a ration containing whole cottonseed with a recommended (NRC) daily dry matter intake of 13 kg results in the potential intake of nearly 12 g of free gossypol per day. It is likely that bulls with free choice access to the lactating cow ration will consume greater than 13 kg of feed per day, thereby ingesting greater than 12 g of free gossypol per day. Unfortunately, it is not definitively known the level at which gossypol intake becomes detrimental to bull fertility. Nevertheless, the published negative effects of gossypol on sperm morphology and motility should not be ignored. It is imperative that dairy producers and veterinarians remember that fertile bulls have more viable sperm and a consistently lower incidence of morphologically abnormal sperm than infertile or subfertile bulls. At the very least, all cottonseed products should undergo chemical analysis prior to ration formulation, especially when bulls have access to the lactating cow total mixed ration. Seek advice from a qualified nutritionist for further information regarding sampling, laboratory analysis, and interpretation of results. Finally, all bulls should be subjected to routine breeding soundness exams to monitor semen quality.

West Nile Virus 2003

Last summer West Nile Virus (WNV) continued the march westward. First discovered in the Western Hemisphere along the East Coast in 1999, by 2002 WNV spread to 44 states with 4,156 human cases and 284 deaths. This summer human cases of WNV are concentrated along the Gulf Coast and in the Mid-west. As of the week ending August 6, 2003, CDC reported positive West Nile Virus blood samples from 1 person in Kansas, 2 in New Mexico, 6 in Nebraska, 8 in South Dakota, 19 in Texas, and 72 people in Colorado.The majority of the Colorado positives are from people living along the Front Range in Larimer, Weld, Boulder and Pueblo Counties. There have been no human cases reported yet this summer in states west or north of Colorado. Information on the status of WNV in your area can be found at <http://westnilemaps.usgs.gov/>

While most WNV infected humans have no symptoms, a small proportion develop mild symptoms that include fever, headache, body aches, skin rash and swollen lymph glands. Less than 1% of infected people develop more severe illness that includes meningitis (inflammation of the spinal cord) or encephalitis. A small proportion of the people developing encephalitis die.

If WNV is identified in your region, it is recommended to reduce exposure to mosquitoes by wearing protective clothing, applying effective insect repellant, fitting doors and windows with screens, and curbing outdoor activity at dawn and dusk when mosquitoes are most active. Since the outdoor activity recommendation is not practical for people working on dairies, special efforts should be made to use insect repellant and protective clothing.

Western Dairy News *is published as a service to the people interested in the health and welfare of the western dairy industry. Archives of this publication may be found at http://animalscience-extension.tamu.edu/dairy/wdn/wdn.html*

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