Ionophores have been fed to beef cattle in the U.S since 1977. In 2004, monensin sodium (Rumensin—trademark name marketed by Elanco) was approved by FDA to be fed to lactating and dry cows in the U.S. Rumensin will be referred to in this paper instead of monensin. Areas of interest and concern raised by dairy managers, consultants, and veterinarians will be summarized in this paper.

### Effects of Rumensin

Rumensin is an ionophore, classified as an antibiotic, is produced naturally by a bacteria strain (*Streptococcus cinnamomensis*) and is fed as a sodium salt. It functions by creating a shift in ion transfer across a cell membrane. In order to maintain cell ion equilibrium, the affected bacteria must use energy to correct the ion imbalance reducing bacteria growth. Gram negative bacteria (starch fermenting bacteria) are more resistant to the action of Rumensin than the gram positive bacteria (fiber fermenting bacteria). Rumensin selectively inhibits gram positive bacteria and shifts the rumen population and volatile fatty acid profile. Rumensin inhibit lactic acid producing strains of bacteria such as *Streptococcus bovis* while not inhibiting major stains of lactic acid utilizing bacteria. In beef cattle, Rumensin also reduced variation in feed intake with smaller and more frequent meals. Both responses could reduce the risk of sub acute rumen acidosis (SARA) in dairy cows.

**Take home message**

Because fiber fermenting bacteria can be negatively impacted, levels of fiber, fiber form, starch, fermentable carbohydrates, and rumen pH will impact animal response when adding Rumensin.

### Impact on Rumensin in Lactating and Dry Cow Rations

An improvement in feed efficiency in Table 1 reflects the shift in VFA (volatile fatty acid) production with more propionic acid produced and less methane lost as rumen gas, improved nitrogen metabolism (less degradation of amino acids and peptides to ammonia), reduction of rumen bloat (cattle on pasture), and decrease in lactic acidosis (shifting microbial population to reduce lactic acid accumulation). The increase in propionic acid results in high blood glucose levels as the liver converts propionate to glucose. Decreases in acetic and butyric acids may also occur. Holstein cows responded to Rumensin more favorably than Jersey cows in limited studies.

In transition dairy cows, subclinical ketosis as measured as 1200 to 2000 umol per liter of beta hydroxyl butyric acid (BHBA) was reduced by 50 percent in field studies in 25 commercial Canadian herds with 1010 cows using the control release capsule (CRC) providing 330 mg of Rumensin per day. The duration of subclinical ketosis and the incidence of displaced abomasums (DA) were also significantly reduced. Serum glucose levels in cows receiving the CRC increased by 15 percent after calving. A Canadian study reported a 40 percent reduction in both clinical ketosis and DA. A numerical trend for lower retained placenta was reported.

Body condition score (BCS) had an impact on milk production response in a Canadian study. Cows classified as thin (BCS < 3.0) at three weeks...
before calving had no significant milk production response in the first 90 days after calving. Cow classified good BCS (3.25 to 3.75) had a significant increase in milk yield of 1.9 pounds or 0.85 kg while heavy cows (> 4.0 BCS) increased milk by 2.6 pounds or 1.2 kg.

In a Dutch study, Rumensin reduced the rate of intra mammary infection, defined as above or below 250,000 somatic cells, by 13 percent (31 percent in control cows compared to 18 percent in supplemented cows). No changes were reported on the duration of intra mammary infection, lameness, cystic ovarian disease, or reproduction (days to first observed estrus and first service conception).

Take home message
Rumensin has positive benefits by increasing serum glucose, reducing ketosis risk, increasing the level of available amino acids with less protein degradation, and improving feed efficiency with less methane production.

Changes in Milk Yield and Components
Research under pasture and confinement feeding systems reported an average increase of 2.2 pounds (1.0 kg) of milk. Milk protein levels parallel milk volume increases while the milk protein percentage was constant. If a milk protein test response occurs, it could be reflect amino acids available for the mammary gland to synthesize milk protein. Milk fat yield and percentage can vary. Feed form, type of oil, and/or level of starch and NDF can lead to lower milk fat test.

- The amount feed particles over 0.75 inch on the top screen on the Penn State Box can impact fat test due to lower rumen pH. When Rumensin was supplemented to a low fiber ration, control cows averaged 3.68 percent milk fat while supplemented cows averaged 3.36 percent. Cows fed normal fiber diets experienced smaller fat test drops as control cows averaged 3.60 percent while the supplemented cows average 3.44 percent.
- High levels of rumen fermentable starch can lower rumen pH leading lower milk fat test with Rumensin due to lactic acid and VFA production, less buffer and saliva production, and changes in rumen turnover and rate of passage.

- Feeding unsaturated fatty acids can lead to the formation of CLA or conjugated linoleic acids (trans C-18:2) when the rumen pH is low. Two conditions are needed for the production of trans-10, cis 12 CLA: an altered rumen fermentation and source of polyunsaturated fatty acids.

Feeding soy oil lowered fat test and fat test was depressed more with added Rumensin. Control cow produced 3.76 percent milk fat, Rumensin supplemented cow averaged 3.74 percent fat, soy oil added to ration to cows resulted in 3.14 percent fat, and soy oil and Rumensin supplemented cows averaged 2.43 percent milk fat. Feeding distillers grain (over 5 pounds of dry matter) has lower milk fat test with Rumensin supplementation in the field. If dairy herds were at breed average or higher milk fat test, no significant milk fat test drop occurred compared to herds that were 0.2 fat percentage point or more below breed average (for example, Holstein herds at 3.5% may experience lower milk fat test).

Take home message
If milk fat test is lower, review the ration for factors that could lead to a decrease. A drop of greater than 0.1 milk fat test percentage can lead to a negative economic response. A response of 1.5 pounds more milk is needed recover the lower milk fat yield due to lower fat test.

Levels of Rumensin
The amount of Rumensin fed to lactating cows can vary from 11 to 22 gram per ton of TMR dry matter per day. Managers and nutritionists targeting the lower level of 11 grams per ton add 250 to 300 mg per cow for lactating cows. Stepping up the level is legal for component fed herds. Rumensin will impact rumen fermentation. Allowing rumen fermentation to adjust to lower Rumensin levels can reduces the impact on milk fat test. Because dry cows consume half of the dry matter of lactating cow, the higher level of 22 gram per ton is recommended leading to 250 to 275 mg a day. One guideline is adding 0.3 milligrams per pound of body weight. For example, a 1000 pound Jersey cow would calculate to be 300 milligrams. To calculate the amount of Rumensin fed, divide the level of Rumensin added to a ton of TMR dry matter (11 mg per ton for example) by two to get the
milligrams per pound of TMR dry matter (for example, 11 mg per ton / 2 equals 5.5 mg per pound of dry matter times 50 pounds of TMR equals 275 mg per cow per day). If excessive levels of Rumensin are accidentally fed, cows will go off feed in 24 hours, loss manure in 36 hours, and sick cows in 48 hours.

Take home message
The level of Rumensin will vary depending on feed intake and rumen status. Stepping up the level is recommended starting at one third to one half of the target level allowing the rumen to adapt to the product for one to two weeks. Monitor feed intake, manure consistency, and milk components during this period. If milk fat does not change, do not exceed the recommended level.

Economic of Rumensin
Adding 250 to 300 milligrams of Rumensin can cost 2 to 4 cents per cow per day. Table 1 indicates an increase of 0.7 pound of 3.5% fat corrected milk results in an increase of 8 to 12 cents per day (5:1 benefit to cost ratio). Feed efficiency calculated as pounds of 3.5% fat correct milk per pound of dry matter increased from 1.50 to 1.56. Each increase of 0.1 feed efficiency point is worth 15 to 20 cents. Energy efficiency values in Table 1 reflect the increase in milk yield, gain in body condition, and decrease in feed intake. In a Canadian field study of 95 herds, the return over feed costs for Rumensin was 69 cents (Canadian dollar) per day including milk improvement, rumen health, and BCS impact.

Take home message
The economics and efficiency improvements are impressive when feeding Rumensin.

Label Changes with Rumensin
In December, 2005, FDA approved the feeding Rumensin to dairy cows in a component feeding systems. This new approval allows Rumensin to be top dressed, fed in a partial TMR such as pasture or separate hay bunk, fed in parlor grain feeding system, and in electronic feeders. The new guidelines allow 185 mg to 660 mg for lactating cows and 115 to 410 mg per day per dry cow expressing intake as milligrams per day instead of milligrams per ton of dry matter. A minimum of one pound of Rumensin-containing feed MUST be fed to each animal per day to meet FDA requirements. Broader labeling for replacement heifers was also added covering more heifer feeding approaches (freestall barns, tie stall systems, group pens, heifers on pasture, and heifers on dry lot).

Take home message
Rumensin can be stepped up legally if the level is the recommended ranges and can be fed to a wider range of feeding systems.

Future Applications and Consideration
Dairy managers and consultants should considering strategic addition of Rumensin to dry cow and lactating cow rations. The impact of Rumensin on lowering lactic acid levels could have future impact to reduce subacute rumen acidosis diminishing the need for direct fed microbial (DFM) products. The CRC used in Canada for dry and fresh cows that dispenses 330 mg for 90 days on a 24 hour/7 day basis is impressive for transition cows. Approximately 18 percent of Canadian dairy herds use CRC. New research from the University of Pennsylvania indicated a significant drop in the number of Johne’s disease-causing organisms in the manure and tissue of dairy calves fed Rumensin. Calves were experimental exposed to moderate level of infection using an oral dose of *Mycobacterium avium* subspecies *paratuberculosis* (MAP).

Take Home Messages
- Rumensin is a feed additive that should be included in lactating and dry cow rations at 250 to 300 mg per day or 11 to 22 mg per ton of ration dry matter.
- The benefit to cost ratio (5:1) and feed efficiency (2 to 4 percent) responses to adding Rumensin are favorable.
- Monitoring milk fat test is critical to insure a positive economic response.
- Less ketosis, displaced abomasums, and rumen acidosis and improve transition cow health support the use of Rumensin in dry, transition, and lactating cow rations.
- Changes in December, 2005, by FDA provide more flexibility in positioning Rumensin in dairy cattle rations.
Table 1. Summary of effectiveness of monensin by level (nine studies).

<table>
<thead>
<tr>
<th>Level of monensin (g/ton)</th>
<th>Control</th>
<th>11g/t</th>
<th>15g/t</th>
<th>22g/t</th>
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<tr>
<td>Dry matter intake (lb/day)</td>
<td>43.9</td>
<td>43.4</td>
<td>42.8</td>
<td>42.3</td>
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<tr>
<td>Milk yield (lb/day)</td>
<td>65.0</td>
<td>66.7</td>
<td>66.8</td>
<td>67.5</td>
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<td>Milkfat (%)</td>
<td>3.65</td>
<td>3.53</td>
<td>3.49</td>
<td>3.38</td>
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<td>Milk protein (%)</td>
<td>3.15</td>
<td>3.13</td>
<td>3.13</td>
<td>3.10</td>
</tr>
<tr>
<td>Solids corrected milk (lb)</td>
<td>58.2</td>
<td>58.6</td>
<td>58.0</td>
<td>58.0</td>
</tr>
<tr>
<td>3.5% FC milk (lb)</td>
<td>66.1</td>
<td>66.8</td>
<td>66.7</td>
<td>66.0</td>
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<tr>
<td>Feed eff (lb 3.5/lb DM)</td>
<td>1.50</td>
<td>1.54</td>
<td>1.56</td>
<td>1.56</td>
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<tr>
<td>Energy efficiency (%)</td>
<td>control</td>
<td>+2.0</td>
<td>+2.5</td>
<td>+4.0</td>
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References


