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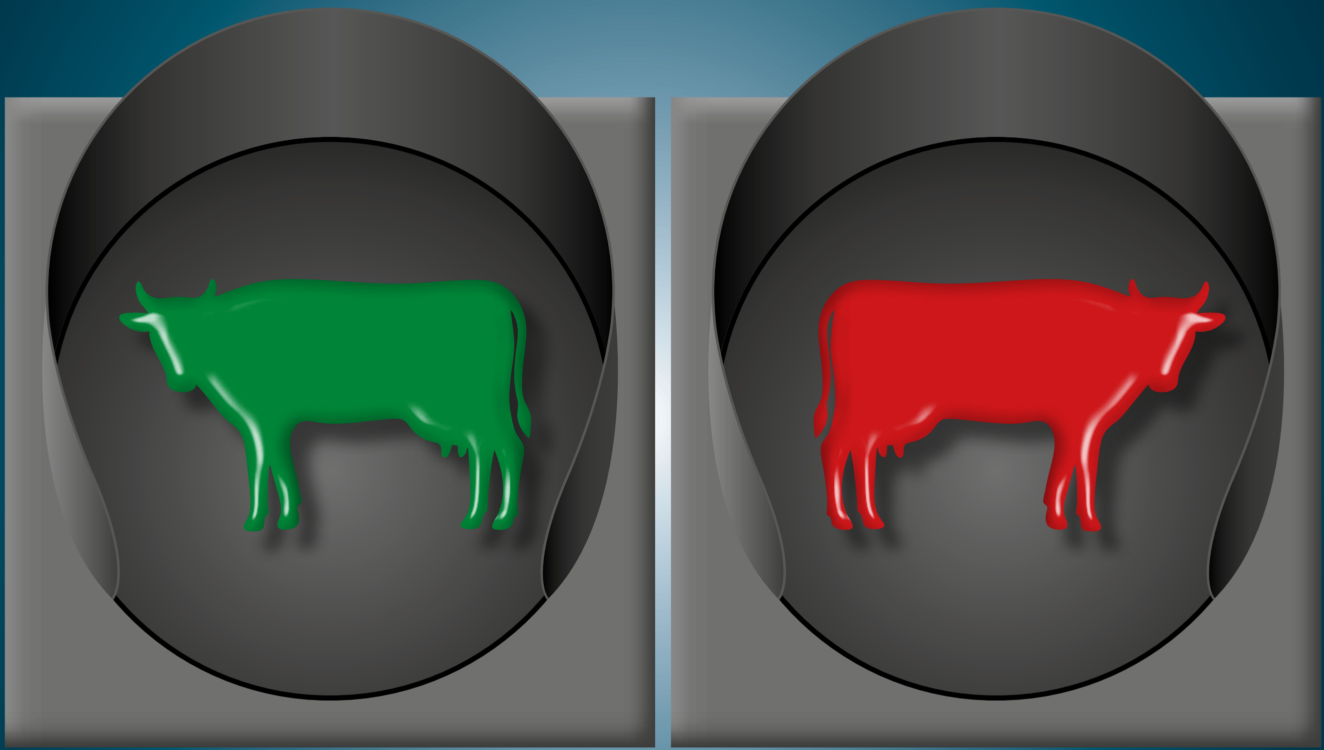

Trouble with On/Off Mycotoxin Risk Management

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Photo: visual7

Case study

Dairy farm in China

Photo: Nenadpress

Tackling acidosis

The dangers of SARA

Editorial

The Race Continues

In April we noted that, in the absence of the EU milk quota system, competition to produce milk efficiently would mount considerably. Few anticipated that increased production by major markets would be met by a slowdown in demand from China and elsewhere, wreaking havoc on milk prices.

A common response from farmers facing low prices is to cut costs. In this issue of **Science & Solutions** we explore the case of a dairy farmer in China who, in an effort to reduce production costs, suspended the farm's mycotoxin risk management program. While initially put in place to counteract aflatoxins, the program's removal revealed a whole new set of challenges caused by other mycotoxins and reinforced the need for consistent application of mycotoxin risk management.

We then turn to subacute ruminal acidosis, or SARA, a difficult to perceive challenge that a dairy cow can face during her lactation that affects milk production, general health and longevity. We look at a number of steps farmers can take to maintain a more stable rumen pH and keep cows healthy.

Worldwide dairy production is expected to increase by nearly a quarter in the coming decade while prices are expected to decline slightly in real terms (e.g. after inflation). This suggests that the race towards greater efficiency and maintaining healthy herds will continue to define the industry in the years to come.

Christine Hunger

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The Perils of On/Off Mycotoxin Risk Management

By **Simone SCHAUMBERGER**, Product Manager Mycotoxin Risk Management

A dairy owner's recent experience demonstrates the risk of occasional application and highlights how mycotoxins can affect dairy herds and profits.

Like most dairy farmers, the owner of a 1000-head dairy operation located northwest of Beijing, China, was well aware of the dangers posed to cows by aflatoxin-contaminated feed. He was also conscious of the risk of carryover of ingested aflatoxins into milk at a rate ranging from one to six percent that could endanger human consumers.

With this information at hand, he decided to implement a mycotoxin deactivating feed additive at 20 to 25 grams per day per cow. A few months passed without issue. Plans to construct a new barn faced headwinds when the price of milk dropped and production cost pressures mounted—leading the dairy owner to cease the mycotoxin risk management program. In just a few days, the herd's abortion rate climbed significantly. The total mixed ration (TMR) had only trace amounts of mycotoxins, indicating that the alfalfa silage was the likely source of mycotoxin contamination. The owner reintroduced application of Mycofix® at a similar dosage as before, and within a few days everything had returned to normal. This case reveals a number of important facts about how mycotoxins affect dairy production.

Aflatoxin not the only danger

The reproductive issues observed in this case were likely the results of zearalenone, a potent estrogenic mycotoxin linked to a number of reproductive issues. The most well-known mycotoxins, recommended risk thresholds and effects are listed in *Table 1*. According to the annual BIOMIN Mycotoxin Survey, several major

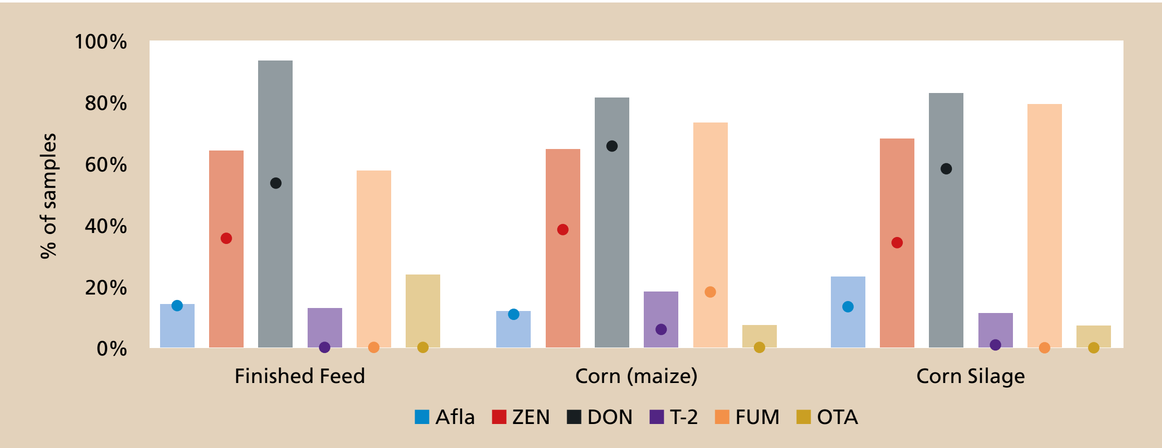
Table 1. Major mycotoxins and the dangers for cows.

Mycotoxin	Recommended risk threshold (ppb)	Effects
Aflatoxin	2	• Weight loss and reduced weight gain (cattle) • Impaired rumen function • Impaired udder health, increased somatic cell count • Decreased resistance to environmental and microbial stressors; increased susceptibility to diseases
Zearalenone	100	• Infertility, decreased conception rates • Teat enlargement • Enlargement of mammary glands in virgin heifers • Reproductive tract infections
Deoxynivalenol	300	• Impaired rumen function • Diarrhea • Metabolic disorders, mastitis, metritis • Lameness
T-2	100	• Loss of appetite • Gastroenteritis • Lowered milk production • Reduced immune response
Fumonisins	2000	• Decreased milk production and increased levels of liver enzymes
Ochratoxin A	80	• Ochratoxin A (OTA) is a nephrotoxic mycotoxin and ruminants are much less sensitive to ochratoxin A compared to non-ruminants

Source: BIOMIN

A common misconception is that mycotoxin risk management is optional or only necessary in response to

Figure 1. BIOMIN Mycotoxin Survey results, January to June 2015
Bars represent percentage of contaminated samples. Dots display occurrence of mycotoxins above risk threshold levels.



Source: BIOMIN

mycotoxins display high prevalence in common dairy cow feed components. *Figure 1* shows the incidence and concentrations of aflatoxins (Afla), zearalenone (ZEN), deoxynivalenol (DON), T-2 toxin (T-2), fumonisins (FUM) and ochratoxin A (OTA) in corn (maize), corn silage and finished feed samples analyzed worldwide between January and June 2015.

The most prevalent mycotoxin in dairy cow feed components was deoxynivalenol, present in 81% of corn and corn silage samples, as well as in 93% of the finished feed samples. Although the average levels of deoxynivalenol in corn and corn silage were above 2,000 ppb, single samples showed levels above 16,000 ppb which clearly exceed guidance and advisory levels imposed by both the US FDA and the EU for dairy cattle.

The average levels of zearalenone detected in corn, corn silage and finished feed (all above 300 ppb) pose a potential health threat to dairy cows due to its estrogenic effects.

On again, off again

A common misconception is that because cows are less sensitive to the effects of mycotoxins than other livestock species that mycotoxin risk management is optional or only necessary in response to a severe mycotoxin challenge. As the case study in China and *Table 1* demonstrate, the reality shatters this myth. Many dairy producers across the world have had similar experiences, forgoing a mycotoxin risk management program when faced with low milk prices or cost pressures, only to have sudden problems relating to insemination rates, lower milk production, diarrhea, elevated somatic cell counts, higher incidence of diseases such as hoof disease or mastitis, and reproductive failure. (See “Mycotoxins in Dairy” in **Science & Solutions**, Issue 13 for further case studies).

A number of factors that can lead to decreased mycotoxin deactivation in the rumen are shown in *Table 2.*

Degradation is not protection

Cows’ lower sensitivity to mycotoxins (compared to other species) is due to their degradation in the rumen. Rumen biodegradation of various mycotoxins happens via certain microorganisms (e.g. protozoa) which have some capacity to metabolize particular mycotoxins.

Simone Schaumberger
Product Manager Mycotoxin Risk Management

a severe mycotoxin challenge.

While some researchers have postulated that toxin degradation can reach up to 90% for some mycotoxins, estimates vary widely and differ for each mycotoxin. Several studies have shown that in the presence of some mycotoxins, rumen microorganisms are altered and do not have the expected detoxification capacity.

High production, unintended consequences

Ruminal transformation does not always render mycotoxins harmless. In the case of zearalenone, which is metabolized via protozoa to α- and β-zearalenol, the beta form has been shown to be a less-toxic metabolite, whereas the alpha metabolite results in an even more estrogenic compound compared to zearalenone itself (Jouary *et al.*, 2009, Dänicke *et al.*, 2005). The level of zearalenone degradation in the rumen seems to be strongly connected to the level of feed intake and the resulting retention time of the feed. High-producing dairy cows with a daily feed intake of 26 kg dry matter, for example, have higher throughput which reduces the time allotted for detoxification.

Undetected invaders

Masked mycotoxins (conjugated forms bound to proteins or sugars) cannot be detected by conventional analytical methods (HPLC, ELISA). During digestion, the intestinal enzymes may cleave the masked mycotoxins and the parent mycotoxins are released. After release, the mycotoxins can again become toxic for the animal.

Acidosis

A well-known problem within ruminants is subclinical or acute ruminal acidosis (SARA/ARA). This syndrome of low rumen pH often occurs in high-producing dairy farms, especially when the feeding regime is impaired or stress situations impair the ruminal flora and lead to dysbiosis.

It is assumed that during acidosis the numbers of protozoa decline and, as one of the most important mycotoxin-degrading agents, this leads to decreased degradation. Therefore, higher levels of mycotoxin can pass to the intestine and exert toxic effects.

Table 2. Factors impeding mycotoxin deactivation in the rumen

Factor	Description
High productivity	Higher throughput reduces time for detoxification
Partial/unfavorable degradation	Higher toxicity metabolites released in the rumen
Masked mycotoxins	Increased bioavailability of the parental mycotoxin
Multiple mycotoxins in rumen	Microorganisms have lower degradation capacity
Acidosis	Dysbiosis results in lower degradation capacity

Source: BIOMIN

Multiple threats

A number of common molds found in the field produce a variety of harmful mycotoxins that impair dairy cow health and performance. The most advanced, commercially available mycotoxin detection methods can identify over 380 different mycotoxins and metabolites (Spectrum 380®). Different groups of mycotoxins differ structurally from one another. While the dairy owner in this case initially implemented a mycotoxin risk management program to counteract aflatoxins, a robust program will combine several strategies, or modes of action, to counteract a broad range of different mycotoxins.

Comprehensive solution

Robust mycotoxin risk management comprises several steps: detection, prevention and mitigation. Regular analysis of feed components and silage can help to uncover potential threats to animals. Good silage management is essential to avoid further growth of molds and thereby prevent the production of mycotoxins. Regular application of a mycotoxin deactivator cannot be overlooked. Proper mycotoxin risk management is essential to avoid unpredictable losses and maintain a high producing dairy herd.

Photo: aleksandr hunta

Tackling acidosis and the dangers of SARA

By **Luis CARDO**, Technical Ruminant Manager

Subacute ruminal acidosis (SARA) is one of many challenges that a dairy cow can face during her lactation, affecting not just milk production, but also general health and longevity. Though not easily detected, SARA can have a serious impact on dairy production.

Photo: nicolasprimola

ARA

Acute ruminal acidosis occurs when the rumen pH drops to a very low level (less than 5.2) with a build-up of volatile fatty acids and lactic acid in the rumen — usually due to an excess of rapidly fermentable carbohydrates coupled with a lack of effective fiber. If not corrected it will cause metabolic acidosis and water from the blood to enter the rumen due to the high osmotic pressure leading to diarrhea, dehydration and finally threatening life. This severe condition is not common in beef operations and even less in dairy.

Technically, a bout of SARA occurs when rumen pH drops below pH 5.8 for dairy and 5.6 for beef for a period of at least three hours. At those thresholds, fiber digestion is reduced and noticeably affects production. It can also result in lower feed intake, lower feed efficiency, and hoof problems.

What causes SARA?

SARA is caused by an imbalance between production of volatile fatty acids (VFA) and their absorption by the rumen walls and the buffering mechanisms of the rumen. If rumen pH continues to fall, changes in the bacterial population and its metabolic pathways will lead to the overproduction of lactic acid, a much stronger acid that is involved in acute acidosis.

Rumen fermentations produce volatile fatty acids that cause a decrease of pH. Higher starch meals push the pH level lower for a longer period of time. This is the reason why total mixed ration (TMR), is capable of maintaining a more stable rumen pH, and consistently achieves better results than systems where cows eat fewer, larger (kg) meals per day.

Methods for detecting SARA and its main practical causes are shown in *Tables 1 and 2*. SARA effects can be broadly divided into effects on rumen efficiency, on feed intake, and finally on lameness.

Rumen effects

SARA will affect feed efficiency, therefore increasing feeding costs, due mainly to the decrease of fiber digestibility.

When pH drops below 6.0, the populations and growth of cellulolytic bacteria and the ruminal fungi decline, impairing fiber digestibility. According to several sources (Calsamiglia *et al.*, 2002; Yang *et al.*, 2002) every 0.1 decrease in pH reduces fiber digestibility by 3.6%. Poor fiber digestibility and lower feed efficiency resulting from SARA translate into increased feeding costs for producers.

One study showed that short bouts of SARA (less than 30 minutes) did not reduce neutral detergent fiber (NDF) digestibility, while repeated bouts of four hours did so. These findings support the use of TMR and free 24-hour access to the feed bunker as key management tools to control SARA.

Feed intake effects

SARA commonly causes erratic eating patterns and reduces feed intake. When pH drops, the cow reduces its feed intake, decreasing the production of acids and driving the pH back to normal levels. Then the cow will resume eating, resulting in another bout of SARA and repeating the cycle. This variation will not only decrease production due to the lower feed intake, but will also reduce the efficiency of the rumen fermentations due to the variation of the nutrients supply, causing further economic losses.

Lameness

Lameness is a major concern in modern dairy and beef production due to its huge implications on welfare and profitability. There is a clear link between acidosis and the inflammation of the lamellar tissue of the hoof, a condition known as laminitis that not only causes problems by itself, but that is as well the first step for other conditions such as sole ulcers and white line hemorrhages.

Although the mechanism of laminitis is not yet totally clear, it is thought that the condition is due to lower systemic pH during acidosis and substances such as histamine (involved in immune response) and endotoxins entering the bloodstream.

Lameness, in its turn, can exacerbate SARA as cows suffering this condition will change their feeding patterns due to the lower number of meals caused by the pain suffered when moving to the feeding bunker.

Improved management

SARA control should be based on adaptation of rumen papillae and microflora, and effective fiber intake. *Table 3* provides a list of management practices to mitigate the risk of SARA.

Luis Cardo,
Technical Ruminant Manager

Table 1. Detecting SARA.

1. Check feeding patterns on TMR. If cows are selectively choosing their feed–evidenced by lots of holes in the TMR—then the ingested fiber and concentrates can differ considerably from the ration
2. Routinely assess and keep records of indicators of possible SARA: butterfat content, manure assessment, laminitis, and individual feed intake patterns

Table 2. Main causes of subacute ruminal acidosis.

1.	Poor adaptation of rumen microflora to diet changes. Common at calving, pairing with other metabolic diseases such as ketosis and related conditions. (See "Addressing Negative Energy Balance in Dairy Cows" in Science & Solutions, Issue 17)
2.	Improper feeding patterns and cows selectively choosing their feed. Physical effective fiber coupled in time with the concentrates is absolutely necessary for the cow to ruminate and therefore mixing the rumen content enhancing the VFA absorption by the rumen papillae and to produce saliva that buffers the rumen contents. Assessing the physical quality of the feed is a crucial step to control SARA
3.	Inappropriate forage size. If too long, cows will choose concentrates over forages; if too short it will not provide the physical effect needed to trigger rumination
4.	Formulation mistakes

Table 3. Steps to address SARA.

1.	Ensure proper rumen adaptation especially at calving when shifting cows from the dry group to the lactation group
2.	Control ingredients' palatability
3.	Ensure homogeneity of TMR and proper forage length cut. Keep records of maintenance of mixer (balances, knives)
4.	Ensure proper access to the feed bunks and an adequate supply of water
5.	Avoid stressful situations such as moving animals too much between production groups
6.	Keep first calving heifers separated from older cows when possible
7.	Resting area. Ensure good layout, maintenance and bedding. Insufficient lying time will cause cows to change feeding pattern
8.	When formulas or forages are changed a smooth transition is highly advisable

Feces assessment and SARA detection

Tip: a heterogeneity of feces in a cow's group in the same lactation stage can be caused by SARA, in this situation some feces will be normal and some too loose. You can use the 1 to 5 scoring system to assess the feces

Score 3

Score 1

Endotoxins

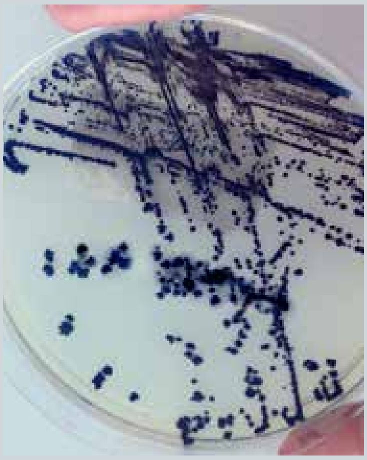


Photo: Scharvik

Lipopolysaccharides, or LPS, are part of the outer membrane of Gram-negative bacteria, and are released during overwhelming growth, lysis or death of bacteria. Control of endotoxins and its production must be a cornerstone in the control of laminitis.

The practical implications are far-reaching, as lipopolysaccharides are produced not just in SARA situations, but also under other situations affecting rumen fermentations, such as mycotoxin challenges. These situations must be considered when assessing the SARA/laminitis situation at farm level.