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High Quality Forage Unlocks Dairy Herd Potential

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Ruminant Technical Manager

A handy diagnostic checklist of symptoms, causes and remedies.

Is money saved, money earned?



Unfortunately, this is not really the case on dairy farms. Low milk prices have a real impact on dairy farmers and most of them are looking for ways to reduce expenses while maintaining milk production.

Feeding costs are the biggest expense category on a dairy farm, accounting for about 50 to 60% of total costs. This is the reason why farmers have to focus on feeding strategies to make their business more profitable.

One simple principle to keep in mind is to resist the temptation to cut resources for non-productive animals. In this issue of Science & Solutions, the value of investing in the first stage of a calf's life is discussed. Similarly, the rule with lactating cows is not to cut anything that cuts milk production. That is bad economics. The focus should be on income rather than feed cost.

Producing high quality forages is a synonym for success on a dairy farm. Protein-rich, highly digestible forage can reduce the amount of purchased feed necessary to maintain high output levels. Accurate harvest planning is crucial, but sometimes weather conditions or a lack of available machinery at the right time can compromise the final quality of the forage.

If forage quality is poor, the only way to supply the animal with enough protein and energy is to rely on concentrates,

which increase ration costs and metabolic pressure. High levels of grains in the diet could lead to subacute ruminal acidosis, which has a detrimental effect both on milk production and animal health. Endotoxins and mycotoxins may then "cooperate" to make the situation even worse.

Despite all efforts, it is not always possible to keep everything under control. The best way to minimize problems is to prevent, rather than try to cure them. BIOMIN has developed solutions to keep dairy farmers naturally ahead.

Enjoy reading this issue of Science & Solutions, keeping you naturally informed.



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Technical Sales Manager

SCIENCE & SOLUTIONS

ISSN: 2309-5954

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High Quality Forage Unlocks Dairy Herd Potential



Zanetta Chodorowska MEng
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Zanetta Chodorowska answers some common questions about how to prepare the best quality forage, ensuring that your high-performing dairy herd is fed for success.

Q: Silage is the main component of a dairy ration. On some farms, it accounts for as much as 60-70% of the ration, whereas on other farms in the same region, the diet contains less than 50% silage. If milk production levels are the same, why is there such a big difference in intake?

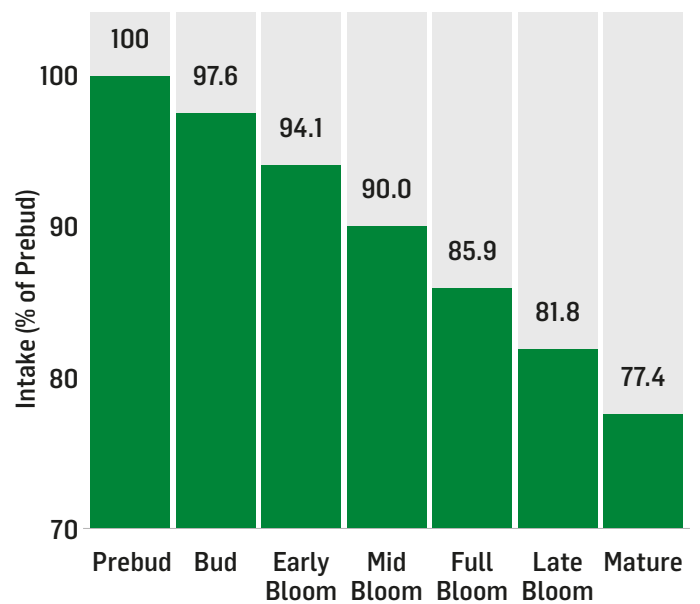
ZC: There are some farms where the problem of low feed intake is practically non-existent whereas on others,



Good quality forage is high in protein.

there is a constant struggle. One reason lies in the preparation and quality of the forage. As it is such a large component of the dairy ration, it has a big influence on feed intake. Forage quality varies according to plant species, variety, fertility, environmental conditions and most importantly, stage of maturity. *Figure 1* illustrates how feed intake decreases as the plant gets more mature.

Figure 1.
Effect of alfalfa-brome greenchop stage of maturity on dry matter intake



Adapted from Hibbs and Conrad, 1974.

IN BRIEF

- Production of high-performing dairy herds can only be sustained when high quality forage is used in the ration.
- Forage makes up a large proportion of the dairy cow ration and so proper attention should be paid to its preparation.
- Compromised forage preparation can be overcome by using silage inoculants prior to ensiling.
- Mycotoxin deactivation products should be added to the ration to protect animals against the harmful and potentially fatal effects of mycotoxin contamination.

In addition, the management practices used for the preservation and storage of the forage are of great importance.

Q: What determines forage quality?

ZC: Protein and energy content play the largest roles in determining forage quality. Good quality forage is high in protein content. This is easily predicted by measuring the plant nitrogen content and multiplying it by 6.25 (the average nitrogen content of protein). Plant maturity at harvest has a large impact on crude protein content. Mature forages have fewer leaves and more stems. Leaves contain soluble proteins like chlorophyll whereas stems are high in fiber and low in protein. Energy content depends on the digestibility of the various chemical fractions of the forage. One common way of predicting forage energy content is by measuring the amount of fiber. Plants that contain large amounts of fiber are generally less digestible.

Q: If forage is grown under controlled conditions on farm, why do we struggle with quality?

ZC: In practice, a lot depends on the priority of the individual farm. Farms focused exclusively on milk production will produce a very different quality forage to those focused primarily on plant production. If the quality of forage is compromised, high costs will be incurred to purchase supplements to correct the forage quality to ensure high milk production. Due to the high demands on machinery, labor and equipment at specific times of the year, especially around the time of first and second cuts of grass and grain harvesting time, the harvest can be delayed, resulting in a lower feed value of the collected and stored material. Forage that is delayed in its collection is difficult to ensile; increased fiber levels result in resistance to compaction and all the associated problems related to aerobic stability. Crops that are harvested late are often contaminated with molds, toxic alkaloids (like those found in most tall fescues) and mycotoxins that enter the bunker silo and pits, and consequently hinder animal performance. Mycotoxins are secondary metabolites of molds belonging to several genera but in particular, *Aspergillus*, *Fusarium*, and *Penicillium* spp. which all cause mycotoxicosis. When livestock ingest one or more mycotoxins, the effect on health can be severe, producing evident signs of disease and in some cases, leading to death.

Q: Is harvest delay a common problem?

ZC: Unfortunately, it is very common. There are farms that manage to harvest on time and milk more than 40 liters per cow per day based on rations with up to 80% forage. To produce such high milk output, the quality of the harvested material must be very high. Feed accounts for approximately 60% of all costs in a dairy operation. If efforts are concentrated on collecting good quality,

Table 1.

NDF intake targets throughout lactation and the dry period

Week of Lactation	Lactation Number (% of BW / day)	
	First	Second or above
2	0.78	0.87
4	0.91	1.00
8	1.05	1.17
12	1.12	1.26
16	1.14	1.29
20	1.14	1.30
24	1.13	1.27
28	1.11	1.24
32	1.08	1.19
36	1.04	1.13
40	1.01	1.08
44	0.97	1.01
Dry cows	0.92	0.95

Source: Mertens, 2009.

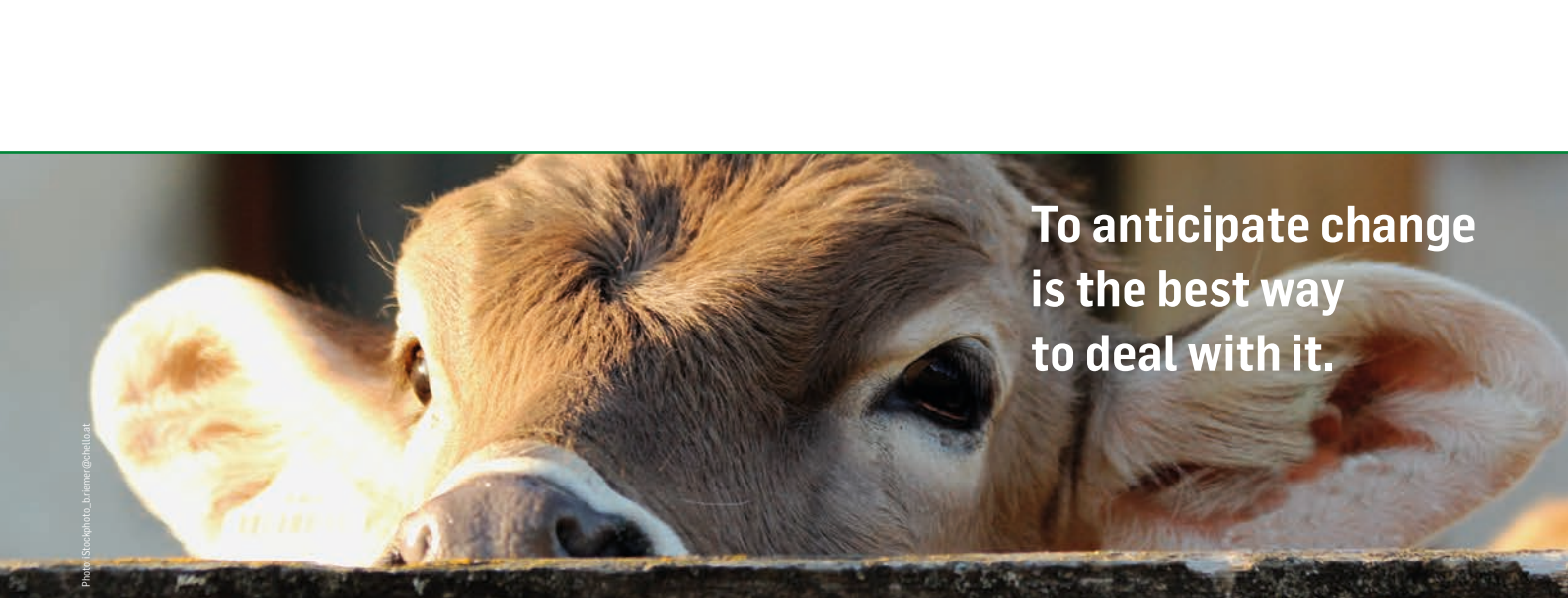
palatable material with a high nutrient content, the cost of purchased feed can be reduced. Associated veterinary bills will also go down due to fewer problems related to low feed intakes.

Q: What does producing high quality forage mean in practice for farm managers?

ZC: We used to say that every year is different, but every year after winter comes spring. Winter is the time where all the necessary work should be done. Here are my top three winter tasks:

- **Carry out a forage inventory** – a calculation of all current forage that is stored, including proper identification of the nutrient value and day of harvest. A forage inventory should be carried out every three months. This will help to avoid unforeseen situations of ration changes caused by poor allocation of forage (e.g. running out of corn silage or having to switch from grass to corn silage in a ration). Cows do not adjust well to ration changes.
- **Analyses** – the nutritional value of all stored material with separate analyses for mycotoxin contamination should be carried out.
- **Planning ahead** - to anticipate change is the best way to deal with it.

The use of silage inoculants is common to control fermentation and reduce dry matter losses. Biostabil® Plus for grass encourages proper fermentation and supports



To anticipate change
is the best way
to deal with it.

the aerobic stability of the forage. Mycotoxin prevention costs are much lower than the cost of fighting disease. Mycofix® Plus is the only registered product in EU that is recommended for the deactivation of mycotoxins.

nutritional value due to shrinkage. When harvest is delayed, the cutting length should be reduced, and proper attention should be paid to the compaction and covering of the forage.

Q: How much forage is needed on the dairy farm?

ZC: The amount of forage needed by a lactating dairy cow is based on dry matter (DM) intake and the concentration of forage in the diet (*Table 1*). The same is true for non-lactating animals and young stock. Optimum forage intake (the amount of neutral detergent fiber (NDF) needed to support maximum milk production), has been calculated by Mertens (2009) as 1.2% of the body weight of the cow. This applies to cows in mid and late lactation.

Q: Are there any other suggestions for when the forage harvest is delayed?

ZC: The amount of silage that has a high NDF content should be reduced in high lactating cows, and replaced with purchased feed. For dry cows, those in late lactation and growing heifers, it should be sufficient to include a mycotoxin deactivation product such as Mycofix® Plus with the forage, and include it in the ration as normal. An alternative solution is to replace the low-digestible silage with by-products that are high in NDF, but that also have a high neutral detergent fiber digestibility (NDFD) such as soy hulls, beet pulp and in some situations citrus pulp. These products offer a more rapid source of NDF that is highly digested. The mycotoxin content of by-products is generally high so there is a need to use Mycofix® Plus to provide full protection against all mycotoxins.

Q: What is NDF?

ZC: Neutral detergent fiber, or NDF, is the most common measure of fiber used for animal feed analysis. It includes most of the structural components of plant cells. Fiber is inversely correlated to energy content. Too much fiber in the ration reduces passage rate, limits intake and supplies only a moderate amount of energy for milk production. Cows fed with high levels of fiber in the ration remain healthy, but do not produce milk to their full genetic potential. If the forage harvest is delayed, NDF content increases which consequently means that less forage should be used in the ration. On the other hand, a deficiency of fiber in the dairy ration leads to rumen acidosis and other metabolic disorders so a balance must be found.

Q: Can NDFD in forages be too high?

ZC: In practical conditions, it is unusual for forage to be too digestible. It could occur when, for example un-matured, very early cut grass containing a high sugar content and high NDFD content is ensiled. This could be counteracted by reducing the amount of grain in the ration.

Q: What can be done if forage harvest is delayed?

ZC: Every effort should be made to avoid delays to the forage harvest. However, when a delay does occur, silage inoculants should be applied to speed up the fermentation process and increase the digestibility of the ensiled material. One good solution is to use BioStabil® Plus, as it will also reduce shrink losses during storage and feeding. Material that is ensiled without inoculants can lose as much as 20% of the

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Mertens, D.R. (2009). Maximising Forage Use by Dairy Cows. WCDs Advances in Dairy Technology. 21. pp. 303-319.

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The Link between Endotoxins and Mycotoxins



Timothy Jenkins PhD
Development Scientist

The two main toxin risks for dairy production and cow health are mycotoxins from fungi and endotoxins from bacteria. Both types of toxin can exacerbate the health risk to the animal of the other toxin. We explore the links between these very different toxins and how best to manage both risks.



Toxins from within

One of the problems with endotoxins is that they can be produced in the rumen. Not all types of bacteria produce endotoxins, only Gram-negative bacteria. The term Gram-negative is based on reaction to a Gram stain under the microscope. Gram-negative bacteria do not retain the stain, mainly because the structure of their cell wall includes lipopolysaccharides (LPS or endotoxins) on the outer membrane. When Gram-negative bacteria die, the endotoxins are released. During fast growth of Gram-negative bacteria, there can also be significant “shedding” of endotoxins.

Endotoxins are always present in the rumen to some extent, but at higher levels, they can compromise the integrity of the gut wall and impact animal health. Endotoxin production is one potential consequence of acidosis because as higher levels of grains are fed, there is a general shift from Gram-positive to Gram-negative bacteria. *Figure 1* shows how the level of endotoxins increases significantly if the rumen remains at a pH below 6 for a prolonged period of time. Sub-acute ruminal acidosis (SARA) challenge is often described as the rumen pH being below 5.8 for more than five hours per day, thus SARA also represents an endotoxin risk.

Endotoxins may affect the tight junctions or cause apoptosis of epithelial cells, increasing the uptake of undesirable substances into the blood stream. Endotoxins

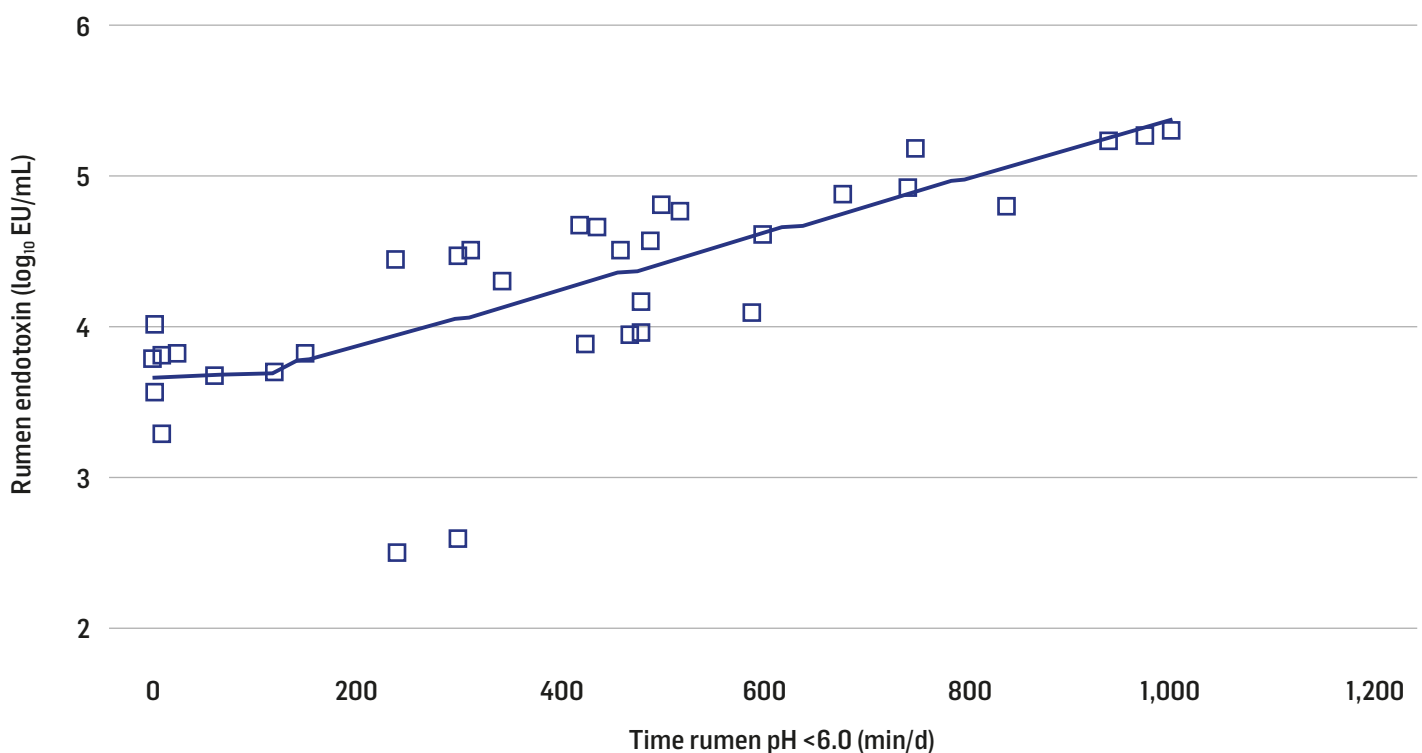
IN BRIEF

- Endotoxins can be produced in the rumen by Gram-negative bacteria. Mycotoxins are ingested through contaminated feed ingredients.
- At higher levels, endotoxins can compromise the integrity of the gut wall, allowing more undesirable substances, including endotoxins and mycotoxins, to pass into the bloodstream, impacting animal health.
- The presence of mycotoxins can increase the uptake of endotoxins and the presence of endotoxins can increase the uptake of mycotoxins.
- The multicomponent strategy of Mycofix® can help overcome the combined effects of endotoxins and mycotoxins.

themselves are also able to enter the bloodstream and research suggests a link between endotoxins and laminitis (*Figure 2*) and other health issues. One of the key impacts of endotoxins is an inflammatory response, which represents a waste of energy for the animal as well as cell damage leading to health issues. *Figure 2* shows how the Biomin® Bioprotection

Figure 1.

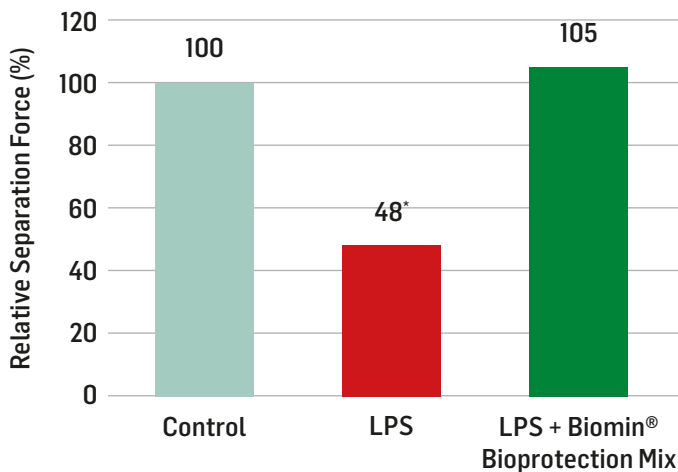
SARA and endotoxins. Increasing endotoxin concentrations (in EU endotoxin units/mL) found in rumens that had longer duration per day of pH below 6. Note: the endotoxin axis is on a log scale so at 5 the endotoxin concentration is ten times as high as at 4.



Source: Zebeli et al., 2012.

Figure 2.

The link between endotoxins and laminitis in cattle and horses. Endotoxins (LPS) in an “ex vivo, in vitro” experiment reduced the force required to separate layers of the hoof (indicative of laminitis). The asterisk indicates a statistically significant effect ($P < 0.05$). The hoof material was unaffected when the Biomin® Bioprotection Mix was added.



Adapted from Reisinger et al., 2017

Mix in Mycofix® can reduce some of this damage. The response to endotoxins can also reduce the appropriate immune response, thus increasing disease susceptibility.

The high osmolarity due to soluble carbohydrate levels associated with SARA may increase the amount of endotoxins crossing into the bloodstream. High osmolarity leads to increased water flow out of the bloodstream, resulting in some dislodging and eventually the death of epithelial cells, allowing increased uptake of endotoxins and other undesirable substances, such as mycotoxins.

Mycotoxins and Endotoxins

Some mycotoxins, such as the common trichothecenes, can also have an impact on the intestinal barrier function and so increase the risk of endotoxin uptake into the bloodstream. Similarly, the negative effect of endotoxins on the rumen epithelium may increase the uptake of mycotoxins, increasing the risk to the animal of even hard-to-absorb mycotoxins such as fumonisins. Both mycotoxins and endotoxins can trigger inflammatory and immunosuppressive effects

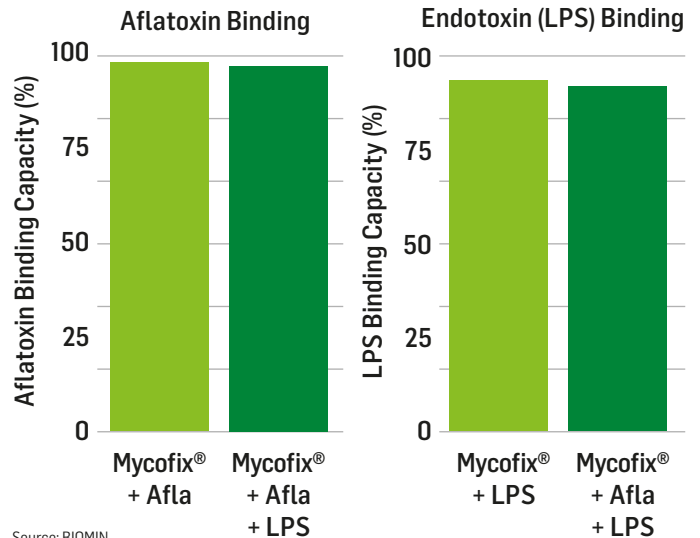
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Zebeli, Q., Metzler-Zebeli, B.U. and Ametaj, B.N. (2012). Meta-analysis reveals threshold level of rapidly fermentable dietary concentrate that triggers systemic inflammation in cattle. Journal of Dairy Science. 95(5). pp. 2662-2672.

Figure 3.

Simultaneous binding of aflatoxin and endotoxins. Left hand side: *In vitro* adsorption efficacy of Mycofix® Plus (0.02%) on aflatoxins (4000ppb) remains the same in the presence of a high level of endotoxin (500 EU/mL). Right hand side: *In vitro* adsorption efficacy of Mycofix® Plus (0.02%) on endotoxin (LPS) binding was similar in the presence or absence of aflatoxins.



Source: BIOMIN

(through reducing response or directly affecting immune cells) and both toxin types can affect, and be exacerbated by, liver damage.

The Effect of Heat

There is a strong link between heat stress and endotoxins. Heat stress increases blood flow to the skin at the expense of the rumen. This deprives epithelial cells of necessary oxygen and allows toxic substances to accumulate. Endotoxin uptake can increase through these damaged cells. Heat stress can also increase the impact of mycotoxins. In addition, both mycotoxins and endotoxins can increase and prolong the negative effects of heat stress.

Management of Endotoxins and Mycotoxins

Management should include steps to reduce heat stress and to balance the diet according to the different demands of productivity and rumen condition. Mycofix® Plus has three strategies to help overcome the combined effects of endotoxins and mycotoxins. An effective binding component can adsorb endotoxins and mycotoxins simultaneously with high efficacy (Figure 3).

In addition to adsorption, a unique and effective biotransformation approach for the difficult-to-bind mycotoxins such as trichothecenes is important to address the direct effects in the animal and their indirect intensifying of endotoxin damage. The third strategy of Mycofix® Plus is to provide protection for the vulnerable epithelial cells, liver cells and immune cells with research-proven bioprotection derived from phytogetic and algal ingredients.

What's Wrong With My Herd?

Part 6 – Calf growth



Bryan G. Miller MSc
Ruminant Technical Support Manager

Economically important in both the short- and long-term, calf health and growth rate can have a large impact on a dairy operation's profitability. The first parameter to consider is simply mortality. A reduction in the number of calves in the system decreases the future herd replacement opportunities. Hopefully, a well-planned breeding program has provided replacement heifers with greater genetic potential for milk production than previous generations. An increased number of replacements allows for greater culling options, or may provide an additional revenue stream to the farm. There are multiple feeding and rearing programs. Different plans will be a better or worse fit depending on the unique dairy operation. This article will not try and cover each scheme, but rather the factors which are important for all operations.

Consumption of quality colostrum

Calves are born without the necessary antibodies needed to protect them. Colostrum contains these needed antibodies (IgGs). During the first day of a calf's life, these IgGs, which are proteins, can be absorbed and subsequently utilized. Colostrum should be consumed as quickly as possible as the gut will "close" and absorption will no longer be available. Calves should be fed 10% of their body weight within the first six hours of life: the sooner, the better. It is important that the quality of colostrum is maintained. Generally speaking, colostrum from older cows is of a better quality than colostrum from younger cows. Cows should also be vaccinated so that the IgGs to those vaccines will also be in the colostrum. For good quality colostrum, the cow must have a strong immune system. Poor protein and energy content, or the presence of mycotoxins in the feed can reduce colostrum quality.

Maternity or calving pens

General recommendations are for pens to be 3.5 to 4 m X 3.5 to 4m in size. They should have a deep bedding of straw or sawdust. Hygiene and comfort are important. Cows prefer an isolated location if possible. Getting the calf dry and ready to receive colostrum are important parts of the calving process. Many producers prefer to feed calves colostrum rather than letting them naturally nurse. Before nursing, make sure that the teat is clean.

Calf milk replacers

There are a multitude of calf milk replacers available with a wide variety of ingredient qualities and compositions. Regardless of formulation, it is important that they provide the protein and energy, along with vitamins and minerals, to support rapid growth of the young calf. Depending upon jurisdiction, antibiotics and coccidiostats may be included in the milk

replacer. Alternatively, producers can use acidifying and phytogetic products that have also been demonstrated to reduce threats from dietary pathogens and support health and growth. These types of products can be particularly important when the calf reaches seven to ten days of age. At this time, the immunity received from the colostrum may not have been fully supplanted by the calves own antibody production. In addition, at this age, calves begin to test eating dry feeds (calf starters) and scours are common. Organic acids and phytogetic compounds can reduce the severity and time of these scours (typically *E. coli*-related).



Calf starter (grain)

It is important for calves to transition from a milk-based diet to a solid-based diet. Consumption of calf starters also stimulates rumen development. Generally, it is better to limit the amount of forage presented to calves during the first two months. Calf starters will actively stimulate rumen development, and contain more energy to stimulate growth. As such, starter intake should be encouraged. Molasses is often used to encourage feed intake. Studies have shown that it should be limited to 5% of the diet. Molasses can potentially lead to greater cleaning requirements or increase fly problems. Using a flavoring system (e.g. a phytogetic product) can encourage calves to make the move from a milk-based to a grain-based diet.

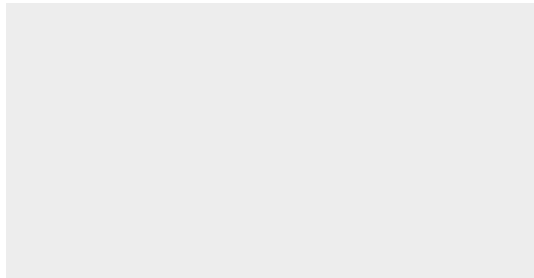
Summary

It is sometimes difficult to know whether calves are healthy because they eat more of a better diet, or they eat more because they are healthier. In the end, it may not matter as we strive for both from the beginning. Faster growing calves not only allow for a transition to a less expensive diet and potentially reduce the number of days to first breeding, but also are higher performing cows once they enter lactation. An analysis of multiple calf trials has suggested that for every 100 g increase in average daily gain prior to calving, they will produce an additional 155 kg of milk during their first lactation. As such, better growing calves not only provide dividends though lower medication and feed costs, but also add to the bottom line as adults.

For more information, visit www.mycotoxins.info

References are available on request

DISCLAIMER: This page contains general advice on ruminant-related matters which most commonly affect ruminants and may be related to the presence of mycotoxins in feed. Ruminant diseases and problems include, but are not confined to the ones present on the page. BIOMIN accepts no responsibility or liability whatsoever arising from or in any way connected with the use of this page or its content. Before acting on the basis of the contents of this page, advice should be obtained directly from your veterinarian.



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