ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS

TECHNICAL BULLETIN

Investigation of feed hygiene

Background:
Silage quality has a heavy influence on animal performance. Unfortunately, some organisms in a farm's environment can rob nutritional value from the feeds that dairy and beef managers maintain. The term 'feed hygiene' refers to the anti-nutritional factors that affect the purity and cleanliness of feeds - from the field, to fermentation, and through feed out in the bunk. Every farm has these risks, but avoiding certain situations, implementing certain management practices, and identifying risk factors through forage analyses can help curb the prevalence or existence of such anti-nutritional factors in the ration.

A successful fermentation, defined by silage quickly reaching an anaerobic state and an acidic forage pH, should result in clean feed, in most situations. Ensiling as described is vital to preventing pathogenic microbial growth and plant aerobic activity. Fermentation bacteria conversion of water soluble carbohydrate into silage acid reduces the silage pH to a range that further stabilizes forage, prohibiting anti-nutritional organism growth. In the event that either of these conditions are not reached, or where field microbial contamination outweighs beneficial fermenting bacterial capabilities, the forage doesn't stabilize and thus provides a welcoming environment for negative microbial activity to ensue

Overview:
While researchers help producers better recognize the impact of feed hygiene and cleanliness upon animal health, finding a perfect solution to combat all the contributing pathogenic aspects remains not found. Identifying these factors as well devising strategies to prevent them from contaminating the daily mixed ration is a vital part of maintaining optimal feed hygiene. In the event that contamination is recognized, identifying all feed hygiene challenges and prioritizing them is vital in creating a mitigation strategy.

Details:
Rock River Laboratory has dedicated resources, people, and time toward specializing in anti-nutritional analyses. The primary goal is to assist nutritionists and their customers in identifying and combating the organisms that pose on farm health and performance challenges. Recognizable symptoms that have been attributed to such challenges include: digestive upset, performance losses or milk component drops, reduced gut motility (feed compaction), hemorrhagic bowel syndrome, or gastroenteritis.

Rock River Laboratory offers a suite of analyses for mold, yeast, mycotoxins, and pathogenic bacteria, while partnering with other laboratories for more involved needs such as toxin panels and biogenic amines. Yeast and mold counts and identification are performed in-house by laboratory technicians that have undergone specialized training and research-backed guidelines are available. Through a research abstract publication, Rock River Laboratory has also validated a rapid mold and yeast enumeration, offering a two-day incubation (three days faster than the traditional technique). This shorter term option helps relieve time-sensitive animal health situations.

Discussion:
Regardless of how the contamination occurs, animal health challenges likely spawn from multiple compounding factors, which fit into four major categories:

1. Fungal contamination: Mold, yeast, and mycotoxins
Mold, yeast, and mycotoxins result from both field and feed-out threats. The presence of actively growing mold or yeast colonies typically suggests aerobic spoilage has occurred and reduced palatability can result. Molds can also produce mycotoxins such as aflatoxin, vomitoxin (DON), zearalenone, T-2, and fumonisin . A considerable amount of animal nutrition research has centered on mycotoxin contamination and impact, and over 18,000 mycotoxins have been identified.

In many circumstances, vomitoxin can be the first toxin to look for as a potential marker for greater contamination. More extensive toxin panels are available, depending on the situation and needs. Depending on the analysis chosen, the level of the mold, yeast, or mycotoxin in the feed, and in some cases, mold species identification, can be determined to develop a plan of action and eliminate the impact of these factors on the ration.

(continued)

2. Environmental and Management Stress

Temperature swings, heat stress, overcrowding, and poor cow comfort are examples of animal stressors that can contribute to suboptimal immune system function and response. Under a stressor, cortisol is released within the animal's body, which in turn suppresses the immune system's ability to recognize and fight pathogens. A new field of research investigating pathogenic microbial interaction with the immune system is recognizing that bacteria can also sense stressed animals and respond. Leading research in the microbial endocrinology field is showcasing how catecholamine stress hormones, which are present in the normal gut environment, are released by the Enteric Nervous System (ENS) during acute stress circumstances. These hormones can be sensed via the receptors of opportunistic pathogenic bacteria. Bacteria then adapt their metabolic systems toward more aggressive induction of pathogenic processes and growth.

3. Nutritional Stress

Nutritional stressors such as inconsistent feed delivery (contributing to an empty bunk or slug feeding), infrequent feed push up, delivering the wrong diet due to errors in mixing or forage dry matter, and excessive rumen bypass starch (poor starch digestibility) can wreak havoc on the rumen and gut. Ill starch digestibility can result in an influx of grain into the hindgut. If it doesn't digest in the rumen, compensatory digestion in the small intestine takes place, which may provide an environment for pathogenic opportunistic fungi or bacteria to take hold.

4. Pathogenic bacterial load

Keeping deleterious bacteria colonies at bay or wiping them out is one aim of the fermentation process. However, inadequate up-front fermentation can create ideal conditions for pathogenic or efficiency robbing bacterial species to colonize and grow. Insufficient fermentation may be a product of inefficient, incomplete, or aerobic deterioration, resulting from poor packing, inadequate sugar load, soil contamination, poor moisture content, seal or plastic damage, or feed contamination at feed-out. In such situations, pathogenic bacterial species such as *Clostridia spp., E. Coli, and Salmonella spp*. can substantially increase in numbers. From a feed hygiene troubleshooting standpoint, the focus has been upon *Clostridium spp*. and more recently total Enterobacteria counts.

Clostridium spp. is a group of spore-forming bacteria that play off poor fermentation. A number of *Clostridium* species thrive in wet and neutral pH growing conditions, which can materialize with sub-optimal ensiling. Fields fertilized with liquid manure application during crop growth, or those fields formerly pastured may see *Clostridia spp.* loads in greater volumes. In addition to degrading protein in silage, *Clostridia spp*. can contribute to feed refusal due to its production of odorous compounds (such as biogenic amines), and can result in increased blood ketone levels.

Gram negative and undesirable bacterial species in the *Enterobacteriaciae* family include *Salmonella, Escherichia coli, Klebsiella*, and *Shigella* among many others. These species are present in the environment and are concentrated in manure and feces. Research suggests adequate ensiling should drastically reduce or eliminate these species from feed, however, more recent exploratory research has identified concentrations between 0 and 105¬ or greater. Further research is warranted to understand the source of this contamination. In better understanding a negative bacterial load in the TMR, consultants can then track back to feeds or feed management practices that could have caused contamination.

Conclusion:

By putting protocols in place for successful fermentation, the risks of anti-nutritional factors are reduced, but more often than not, proactive nutritional management strategies should be followed as more and more detriments to good feed hygiene surface.

References:

Stone, W. & Chase, Larry. (2019). Dealing with Problem Silages: Focus on Clostridium.

Muck, R.E., 1988. Factors Influencing Silage Quality and Their Implications for Management. J. Dairy Sci. 71: 2992-3002.

Seglar, B. 1999. Ruminant Disorders Associated with Pathogens Found within Ensiled Forages. Proc AABP Meeting, Nashville.

Freestone, P.E., S. M. Sandrini, R.D. Haigh, and M. Lyte. 2007. Microbial endocrinology: how stress influences susceptibility to infection. Trends in Microbio. 16:2, pgs. 55- 64.