Is Feed Microbial Quality Attacking Your Profit?

Feed is normally the number one cost related to animal production. For example, in the broiler industry it has been calculated that feed comprises around 80 % of the overall cost of chicken production. Thus, the ability of animals to effectively process feed (digest and absorb the nutrients contained in feed) will finally dictate how profitable an operation will be. Actually, the more competitive the markets get in terms of profit per kg of produced protein, the more important it becomes to be able to extract the most out of feed to maintain a healthy business. So it is not surprising that much attention has been given to feed conversion as one of the main indexes used to judge the productivity of livestock operations.

There are several factors that can affect feed conversion. One of the most important factors that directly affects feed conversion is the soundness of the gastrointestinal system. Therefore, considerable emphasis has been put on enteritis (inflammation of the intestine) in the last two decades. Many farm managers and veterinarians routinely examine the faeces of the animals for signs that can help to detect enteritis early. Watery content, excess of gas, excess of mucus, and poorly digested grain are some of them.

What is Enteritis?

The structure of a healthy intestine is designed to maximise its absorptive and digestive surfaces. Intestinal mucosa is composed of millions of slender villi that, when combined, massively amplify the available surface. When enteritis arises, the cells that compose the villi cannot survive long enough to create the tall and slender structure. The result is that blunt and short villi are formed. As a consequence, part of the absorptive surface is lost, reducing the overall capacity of the intestine to absorb nutrients. The impact of enteritis, therefore, normally stems from a reduced absorption of nutrients plus loss in performance as a consequence of energy expended repairing damaged tissue.

Feed as Cause of Enteritis

Feed has long been identified as a key influencing factor on the gastro-intestinal health of farmed animals. Anti-nutritional factors of grains, mainly moulds and mycotoxins, have received lots of attention from nutritionists and veterinarians around the globe, in part due to extensive technical and marketing campaigns by solutions providers. The availability of funding has also driven research in this area, with a plethora of good scientific material now supporting our understanding of the effects of these toxins in farmed animals. As a result, moulds and their by-products (mycotoxins) are the first elements that come to mind when veterinarians and nutritionists want to test for feed microbiological contamination. With the focus on mould and mycotoxins, the importance of bacterial quality appears to have been somewhat overlooked until now.

Specialists in pathogen control at Anitox, a global operation with headquarters in the US with regional offices in Europe, Latin America and Asia Pacific, have extensive experience evaluating the microbial contamination of feed samples around the world. Every year close to 20,000 samples of feed and raw materials are analysed to monitor the extent of microbial contamination and the effect of Anitox's proprietary technologies to reduce this contamination. With this amount of information, Anitox is able to provide accurate profiles of the microbiological quality of feed and raw materials for their clients in different geographies.

Establishing 'Safe' Limits

It is difficult to establish a 'safe' limit for enterobacteriaceae in feed. Few organisations are willing to venture a number, and those that do – Europe's Product Board for Animal Feed[1], for example – do so based on specific challenges. It suggests 100 bacteria /g mark as a desirable level, most likely because of increased risk of Salmonella contamination as enterobacteriaceae counts rise.

When standards are set for drinking water to be consumed by food-producing animals, though, a different approach is usually taken. A level of 50 coliforms per ml has been recommended by several institutions including North Carolina State University[3] and Mississippi State University[2]. Why, then, is water more commonly scrutinised for bacterial contamination than feed?

One possible answer is that animal feed can be pelleted – a process which involves the application of heat that, in turn, can offer some control of initial bacterial loads. But according to the Anitox database, samples from European feed mills between 2010 to 2015 revealed that enterobacteriaceae levels in pelleted feed averaged 3700 cfu/g, 74 times greater than the limit suggested for contamination in water.

Even considering that animals drink twice as much as they eat, that would still see consumption of feed-source enterobacteriaceae at 37 times the level deemed acceptable according to water standards.

Understanding Variation in Feed

Understanding the causes for and impact of microbiological variation within different batches of feed is vital in order to appreciate the potential impact on production efficiency.

Microbial contamination of raw materials vary by

source, origin, season and handling regime. Generally speaking, feed millers and integrators have limited control over raw materials used in their operations. Purchase managers are challenged by seasonal availability of ingredients and by the prices at which these materials are traded in any given moment. With margins tight and with pressure to keep prices of finished feed low, the origin of an ingredient is usually less important than its price. Conditions under which the raw material were produced or stored can be complete unknowns. Add to that the impact of weather during cropping and storage conditions, and we can begin to understand how and why microbial contamination of feedstuff varies so greatly.

Looking at the European Anitox feed sample data in more detail, we see that 10 % of the most contaminated samples average 36,000 cfu, over 700 times higher than the bacterial level recommended for water. It's worth remembering, too, that those are pelleted samples; samples which have had the benefit of some form of heat treatment, unlike for example, mash that is routinely fed to layers. While this seems high, it is probably just the tip of the iceberg given what we know about the likelihood and extent of post-milling feed recontamination that impacts all feeds other than those treated with residual pathogen control.

Feed contamination trials designed to monitor recontamination post-milling show that risk increases all the way to the feed tray. Storage of finished feeds is part of the problem, with pellets stored in silos where temperatures vary between day and night, leading to condensation on silo walls. This humidity reaches the feed, creating a much more appealing media for bacterial growth. In addition to this, dust inside the silos tends to adhere to the walls. If a silo is not regularly cleaned, a crust of dust and decaying material starts developing inside the silo walls. With the vibrations generated during the loading of the feeders, decaying material in the form of crusts detaches and mixes with the feed. This results in the millions of bacteria and mould contained in these crusts serving as nuclei for contamination of the fresh feed that now surrounds them.

Research shows that by the time feed reaches feeders, we can expect to see an increase in contamination levels of somewhere between 4 and 20 times levels measured at the feed mill. At that point, we can predict that more than 10 % of the pelleted feed consumed by animals would exceed 10,000 times the maximum permissible bacterial contamination levels suggested for drinking water.

Animals that Eat Mash

Most layers, and a good number of pigs, are fed mash feed rather than pellets. Mash production doesn't require the application of heat and therefore does not involve even the most basic bacterial control phase in its production. That means that the full extent of bacterial contamination contained in raw materials goes into the finished feed and straight to the animals.

Looking at the Anitox data once more, we see that in Europe from 2010 to 2015, the average contamination from enterobacteriaceae is 80,000 cfu/g of feed at the feed mill level, with the top 10% most contaminated samples averaging over 700,000 cfu/g of feed. If we consider a modest five-fold increase in bacterial contamination during storage, we can predict that the feeder levels may average 3,500,000 cfu/g, 35,000 times greater than the maximum contamination level recommended for drinking water.

Understanding the challenge in light of the Anitox data, we're brought back to the original question: Why are most people and organisations concerned about microbial contamination of water and not feed contamination?

Is it possible that producers tolerate feed microbial variation precisely because it varies from batch to batch rather than presenting a constant level of challenge, as with water? The same source of water is likely to give a similar microbiological profile for a significant amount of time, while feed quality can change as soon as we receive a fresh batch of feed, which could mean only a couple of days in some cases. Could it be that the erratic pattern of some enteritis observed in the field is mirroring the variation in feed microbial contamination?

Frequently at farm level we see animals with mild enteritis. When the enteritis starts, the farm manager looks for solutions, calls the vet and the nutritionist and before any of the plausible solutions have had time to be implemented, the enteritis is gone. Things return to normal without the need for formal treatment.

Scrutinize the Anitox data and we see that this isn't an incidental risk. If we assume that Anitox samples are typical and apply water quality standards, we see that animals could be receiving a ration carrying a microbial burden sufficient to challenge optimum performance 10% of the time - that's twice a week!

Effect of Bacterial Contamination in the Animal

There are several factors that will determine the effect of consuming contaminated feed. The species of bacteria present will have a tremendous impact. While some organisms present in feed may cause only a modest impact on the nutrients available in the diet, others cause direct damage to the animals. Pathogenic *E. coli* will produce enteritis even if the feed is relatively free of other bacteria. In most cases, however, it is difficult to predict the outcome of bacterial load; there are simply too many complex factors at play. Debilitating factors, immune competency of the animals (including the presence of immune suppressive agents), current and recent diseases, and the physiological stage of the animals, all have a profound impact on the outcome of consuming contaminated feed.

Bacterial load in feed can cause severe intestinal disease in animals, but that won't always be the case. Most of the time the outcome of a single event – a peak in bacterial load leading to enteritis, for example - is not spectacular and usually affects only one part of the farm for perhaps a day or two. For this reason, the importance of these events can be overlooked; they are simply not big enough to top a producer's list of concerns. But overlooking them could significantly impact on productivity. An animal's ability to withstand other diseases will be adversely impacted if they are continuously challenged. If another disease develops, then the solution sought will focus on targeting the new disease, not on targeting the debilitating factors that increased the risk of susceptibility. This approach may offer a short-term solution and the disease threat be solved, but a different disease will follow shortly and the underlying problem is thus not addressed.

In addition to these fundamental considerations, producers should also be mindful of the cumulative impact of multiple low-level drops in performance that follow each episode of enteritis. Add the cost together and over the period of a year the cost of mild enteritis could be taking a good portion of profits away.

As a professor of mine at veterinary school used to tell me: good results in animal production should not be difficult to achieve if we follow three basic rules: provide clean feed, clean water and suitable shelter. That's it.

References

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