

Can we trust the feedstuffs we give to our dairy cows?

Cows have been selected over the years to become ever more efficient, resulting in modern animals which are highly productive, but at the same time very fragile and demanding. Some 25 years ago, the average dairy cow produced 6,029kg of raw milk every year. Twice-a-day milking was the norm, and bovine growth hormones were an emerging topic of debate.

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Today's modern dairy cow produces an average of 9,681kg of milk each year, a 61% increase over the past quarter century. That

means that the average modern dairy cow weighing 680kg may produce close to 5% of its body weight in milk per day of lactation.

Growth hormones and three-times-a-day milking are major factors in the increase. So, too, are high-energy feed rations and genetic selection for animals with maximum milk output. Nowadays, in order for animals to be profitable, cows need to be high producers that maintain good fertility and health status.

However, in many cases this is not the standard situation and many surveys underline how fertility and longevity have decreased over time.

Data from 1957 indicate that 80% of the cows in the Northeastern United States were alive at 48 months of age, while the calving interval was less than 13 months. In the same area nearly 50 years later, the

survivability had fallen by 20% and the calving interval had risen to 15.3 months.

Better management and nutrition

The growing trend of the dairy sector with the increase of high producing, yet more demanding cows, is answering the increasing global thirst for milk and milk-based products.

The forecast for the next decade and beyond is that milk production will increase considerably, driven by consumer demand in emerging markets.

The International Farm Comparison Network (IFCN) forecasts an increase of milk production of 54% in India, 43% in Africa, 27% in China and 43% in Brazil.

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The effects of mycotoxins (DON = Deoxynivalenol, ZEA = Zearalenone, AFB1 = Aflatoxin B1, T-2 = T-2 Toxin, Ergots = Ergot alkaloids endotoxins).

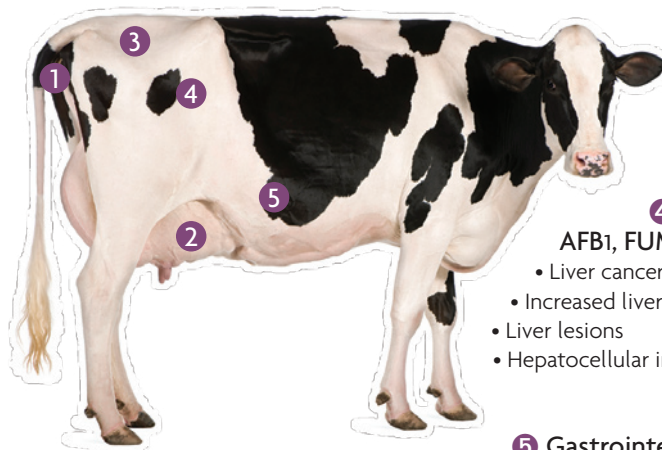
1 Fertility:

AFB1, ZEN, Ergots, T-2, HT-2

- Irregular heats
- Low conception rates
- Decreased milk production
- Ovarian cysts
- Embryonic loss
- Abortions
- Early development of mammary gland in pre-pubertal heifers
- Low testicular development
- Low sperm production
- Low semen quality (T-2, HT-2)

2 Other common complications:

- AFB1, DON, Ergots, OTA, T-2, HT-2
- Impaired thermoregulation
 - Convulsions and neurological signs
 - Mastitis and laminitis
 - Decreased milk production
 - Residues in milk (AFB1)
 - Immune dysfunction
 - Haematological alterations
 - Growth inhibition



3 Kidney health:

AFB1, FUM

- Increased kidney weight
- Kidney lesions

4 Liver health:

AFB1, FUM

- Liver cancer
- Increased liver weight
- Liver lesions
- Hepatocellular injuries (FUM)

5 Gastrointestinal effects:

AFB1, DON, Ergots, OTA, T-2, HT-2

- Gastroenteritis
- Gastrointestinal lesions
- Intestinal haemorrhages
- Impaired rumen function
- Decreased rumen motility
- Shifts in rumen pH and volatile fatty acids production
- Decreased dry matter digestibility
- Decreased crude protein and fibre digestibility
- Diarrhoea
- Ketosis

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Meeting this challenge requires an upgrade to many aspects of dairy farm management. Modern farms must pay careful attention to details and take the latest scientific research and discoveries into account in order to reach the highest levels of success.

New feeding strategies have been developed, namely, the increase of starch and sugars, the use of fatty acids and the reshaping of protein nutrition through the use of the post ruminal amino acid balance.

In addition, new additives have become available that can help to effectively increase animal efficiency, control rumen environment and prevent damage resulting from anti-nutritional factors.

Variability in feedstuff quality

Dairy cows rely mainly on energy, protein, minerals and vitamins for milk production, making the quality of feedstuffs essential in this regard. However, the nutritional composition of cereals and oil seeds is very variable and sometimes inadequate to satisfy a modern cow's requirements, which can jeopardise profitability. Variability can occur in protein content, mineral value and amino acids.

The main protein source for dairy cows, soybean meal, presents fluctuations in its nutritional values, depending on the sources. Recently, 500 samples of soybean with three different origins (US, Argentina and Brazil) were tested in a nine-year comprehensive study.

The researchers analysed various parameters providing a representative view of the qualities of the different sources. As expected, the study showed a huge variation among both in samples of the same area and between samples of different origins – a direct consequence of different cultivar, climate conditions and soil characteristics. Crude protein was higher for US and Brazilian sources, while it was lower for the

Argentinian. The US source showed the smallest variation between the minimum and maximum value, while the widest difference was for the Brazilian one. The amino acids content seems to follow a different pattern depending on the country of origin.

Methionine is the main limiting amino acid in dairy cows. This sulphur-containing amino acid is important for milk production and milk quality.

Knowing the quantity of methionine present in feedstuffs that then reaches the intestine can help to reduce protein diet content, allowing for optimisation of both nitrogen balance and diet cost.

Also, reproduction can benefit from post ruminal delivery of methionine thanks to its effect on liver health and the antioxidant status.

Recently, the University of Wisconsin demonstrated the direct effect of this amino acid on embryo survivability. It is clear that knowing the exact composition of the soybean and its origin can be of great help when balancing amino acids for dairy diets.

Preservation method and microbiological characteristics are important for nutritional quality. For example, corn loses some of its nutritional value when infected by mould. The contaminated grains have a decrease in protein (from 9% to 8%), in fat (from 4% to 1.5%) and, consequently, in energy value.

The nightmare of forages

Considering their peculiar digestive physiology, forages are essential feedstuffs for dairy and ruminants in general. Roughages are necessary to maintain a good rumen health and efficiency.

However, forages are much more variable than cereals, not only in their chemical composition, but also in their digestibility and ability to stimulate rumination.

Furthermore, forage sampling is more complicated due to a less homogenous



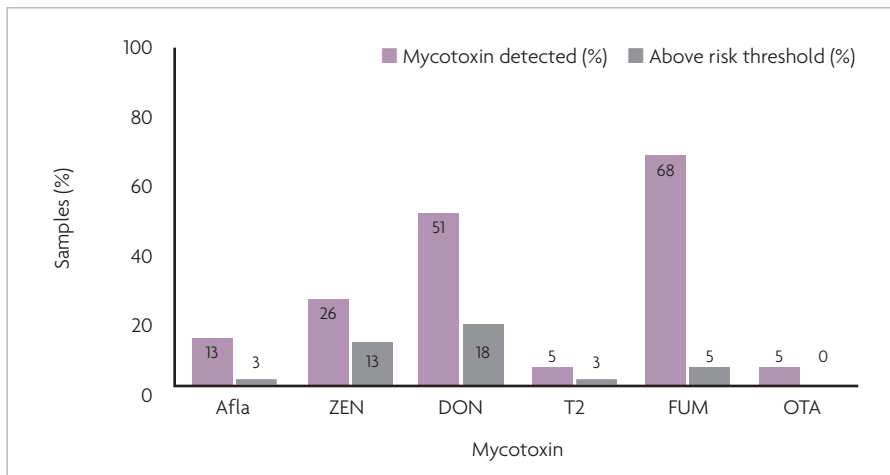


Fig. 1. Mycotoxins contamination on straw (data from Biomin Mycotoxins Survey 2017). The darker orange shading indicates the proportion of samples for which the level of a mycotoxin exceeded a risk threshold for effect on ruminants.

distribution of nutrients than in grain and oilseed. Taking a representative sample presents a real challenge.

Given the double function of forage (nutritional and mechanical), it is clear that mistakes in evaluating forage quality can have severe consequences.

One characteristic that varies the most over time is the dry matter of corn silage and grass silage.

A good rule of thumb is to make weekly analyses of wet forages in order to not overestimate dry matter intake. This simple analysis is often overlooked and considering the high inclusion of wet silages in dairy ration, the risk of energy deficiency and lack of effective fibre can be quite severe.

These types of mistake in the dry matter can quickly compromise animal performance and health, predisposing the animals to ketosis and metabolic diseases. Also the NDF evaluation and its digestibility can be crucial.

Overestimation can increase the risk of Sub Acute Ruminant Acidosis (SARA) in high producing and fresh cows, while an underestimation can slow down the transit time and consequently limit feed intake. In this situation, the dairy cows will be at risk of negative energy balance.

SARA is a pathology that can negatively influence production and health. It stems from an excess of carbohydrates with a fast fermentative profile in a cow's diet, a common feeding technique to meet the high energy demands of modern lactating animals.

Increasing chewing activity, through an effective source of fibre, is one of the most reliable strategies to control this problem. Wheat straw is a good and economical effective fibre source in this regard. It is also often widely available at farm level.

Unfortunately, wheat straw has been shown to be one of the more contaminated forages when it comes to mycotoxins (see Fig. 1).

Grains and forages are not only a source of

nutrients: they can also hide many threats as they may naturally contain several anti-nutritional factors. Some can be mitigated by technological treatments (like antitrypsin factors) but some can persist or even increase during storage and pose a risk for the animal.

The latter is the case of mycotoxins, secondary metabolites originated from fungi and moulds.

A recent survey showed that the majority of the 170,000 known natural metabolites are from fungal origins.

Fungal metabolites include some important pharmaceutical useful substances like penicillin, some components that are both poison and pharmaceutical like ergots alkaloids and some mycotoxins such as aflatoxins and trichothecenes are potent poison for dairy cows.

A wide range of grain and forages can be contaminated by these substances and more than 400 mycotoxins have been identified as of the time of writing.

The Biomin World Mycotoxin Survey, the most wide and comprehensive analysis on mycotoxin occurrence, has shown that risk of mycotoxins contamination remains high with fumonisins, deoxynivalenol and other trichothecenes being the most common mycotoxins present globally.

How we can recognise the mycotoxin risk?

The presence of mould on feedstuffs does not indicate that a feedstuff is contaminated, but it does indicate that the potential for contamination exists. We cannot exclude the risk of contamination on clean- or good-looking feedstuffs.

Mycotoxins themselves are invisible to the naked eye. It is important to bear in mind the presence of masked mycotoxins, the possibility of mycotoxins inside the kernels, the post-harvest production during storage

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and the presence of 'hot spots' not detected during sampling – all of which can pose a contamination risk.

The economic effects on animals are clear and present. The rumen is the key organ for dairy cow digestion, and the composition of feedstuffs impacts its function and its metabolic activity.

Also, the liver is an important organ when it comes to cow nutrition and its efficiency and health can impact performance.

Mycotoxins represent perhaps the main anti-nutritional factors, and they can have a direct negative effect on both organs, and with many others, representing a global threat to ruminants (see inset on page 27).

Many scientific articles have shown that the mycotoxin risk is a reality and not fiction. For example, a recent study has shown that a combination of aflatoxins and fumonisins was able to reduce the growth and increase the age of the first oestrus in heifers. This delay was due to a chronic liver toxicity which reduces the liver's ability to produce glucose.

Deoxynivalenol (the most frequent mycotoxin present worldwide) can reduce rumen function, microbial production, metabolisable protein availability and flux of essential amino acids to the intestine.

Therefore, in case of such trichothecenes' presence in feedstuffs, nutritionists seem obliged to increase the protein level in the



diet in order to keep milk production – an expensive proposition.

Can we trust feedstuffs for dairy cows?

To answer this question we need to accept a proactive attitude. It appears clear that feedstuffs have a great potential to sustain milk production and provide nutrients.

In addition, some of them also contain nutraceutical factors (like natural vitamins or polyunsaturated fatty acids) which can be beneficial for modern dairy cows.

However, it must be acknowledged that feedstuffs have two main drawbacks: the variability and the high contamination by mycotoxins.

For a profitable and healthy herd it is not possible to lockdown these two elements. Therefore, the first step is to perform accurate feedstuffs analyses to know the exact composition of the main nutrients.

It is also important to know the risk that each feedstuff bears, keeping an eye out for anti-nutritional factors.

Nowadays, mycotoxin detection of feed ingredients is common practice and it should also be a high priority considering the worldwide prevalence of fungal metabolites.

As a second step, we need to ensure a proper preservation of feedstuffs. This will guarantee a more stable nutritional composition and will also reduce the magnitude of a second wave of anti-nutritional factors (like storage mycotoxins).

Although reducing animal exposure to mycotoxins is the key to high performance and profitability, we know it is not always possible and often practically impossible when feeding dairy cows.

That is why it is beneficial to apply multi-strategy commercial products (for example adsorption, biotransformation and bioprotection) to counteract the structurally different types of mycotoxins to achieve broad spectrum mycotoxin control. ■

References are available
from the author on request