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Science & Solutions

Mycotoxins in dairy

Tackling the issue

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The mycotoxin challenge

How mycotoxins affect dairy cows and mitigating the effects

China: Rising dairy star

Uncovering the hidden growth potential in China's dairy business

Editorial

Green dairy

Do dairy operations have a place in a "green economy"?

Cattle operations are often criticized for the production of greenhouse gases. It is true that cattle produce carbon dioxide and methane at a greater rate than other species. The gases produced in the rumen have been estimated at 65% carbon dioxide (CO_2) and 27% methane (CH_4), both greenhouse gases.

However, dairy cattle consume large amounts of fibrous feeds, which results in greater gas production than grain diets, allowing the use of land that might not support row crops or would result in serious erosion or other environmental impact. In addition, the carbon fractions released from cattle into the atmosphere were originally taken from the atmosphere to be saved in the plants consumed.

Yes, there can be an addition to overall atmospheric carbon, but it would be from the fossil fuels involved in harvesting feeds, processing food products and food distribution, typical of all food products. The net addition from cattle operations is much smaller when considered under these conditions.

The modern dairy operation is also much more efficient than that of the past. Today's dairies use 90% less cropland, produce 76% less manure, use 65% less water and 63% less carbon than in 1944. With the increased production today's modern dairy cow is capable of, the amount of CH_4 produced per kg of milk has decreased more than 60%. Modern dairy practices provide a good source of dietary protein for a growing human population.

Bryan MILLER
Ruminant Technical Support Manager

Contents

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Mycotoxins in dairy

Facts, figures & solutions

Dairy cows are known to have some capacity to protect themselves against the harmful effects of mycotoxins. This capacity depends on the cow's ability to efficiently deactivate mycotoxins in the rumen, which in turn depends on having feedstuffs retained in this rumen "compartment" long enough to allow rumen microorganisms to work properly.

Karin Nährer, Product Manager, Mycotoxin Risk Management
Inês Rodrigues, Technical Manager, Asia

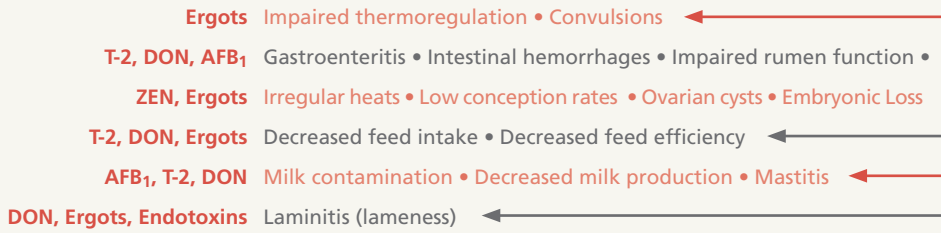
Photo: bizoo_n/iStockphoto

With large amounts of feed comes the risk of increased mycotoxin exposure, higher passage rates and less time available for proper feed digestion. As animals are fed increasing quantities of feed to increase milk yields, it becomes more difficult to guarantee that mycotoxins can be effectively deactivated in the rumen. Complete mycotoxin degradation in the rumen is therefore not possible.

Various mycotoxins are able to modify the rumen microflora as they exert antimicrobial, antiprotozoal and antifungal activity. In practical terms, this means that mycotoxins escape detoxification and are absorbed by the intestine. In other words, mycotoxins disrupt the rumen function before impacting the animal itself.

Drastic changes in feed composition and a high percentage of protein-rich concentrates in the daily diet also impair the cleavage capacity of rumen microorganisms. Reduced ruminal motility, decreased dry matter intake, acid detergent fiber and starch digestion are some negative impacts reported due to the ingestion of mycotoxin-contaminated feed.

Karin Nährer, Product Manager, Mycotoxin Risk Management
Inês Rodrigues, Technical Manager, Asia



• Impaired dairy fertility

Because fertility and milk yield are parameters that are closely related, all factors disrupting fertility have a negative economic impact on herds. Zearalenone (ZEN), an estrogenic metabolite, shows a structural similarity to the female hormone estradiol, and is able to activate specific estrogen receptors.

Thus, ZEN causes abnormal estrous cycles which ultimately impair fertility.

Reduced fertility in dairy cattle has also been reported as a result of ergot alkaloids and aflatoxins.

Case study 1

• Dairy farm in Europe, 50 Holstein dairy cows

Background

The problems experienced in the herd included reduced fertility and more abortions, among others. Feed analysis for mycotoxins revealed levels of ZEN at 120 ppb and B-trichothecenes at 1,000 ppb.

Feedback

Mycofix® was added at 25 g/cow/day in the TMR and fed to the entire herd over a period of 8 months. The average number of inseminations fell from 3.4 to 1.9 with the use of Mycofix®.

The low conception rates before the treatment are indicated by the high percentage of third artificial inseminations.

First insemination conceptions improved from 9% prior to feeding Mycofix® to 43% in the autumn-winter of 2006, which clearly shows improvements in reproductive efficiency.

• Reduced milk production

Deoxynivalenol (DON) has also been associated with reduced feed intake and weight gain and decreased performance.

Several field reports and clinical data have associated DON with reduced feed intake in non-lactating dairy cattle and poor performance in dairy herds.

Case study 2

• Dairy farm Europe, 110 Holstein dairy cows

Background

Feed intake of dairy cows decreased overnight (55% lower) accompanied by lowered milk production, diarrhea and reproduction failure. Mycotoxins were were detected in the corn silage (600 pbb DON, 50 ppb ZEN; based on fresh matter)

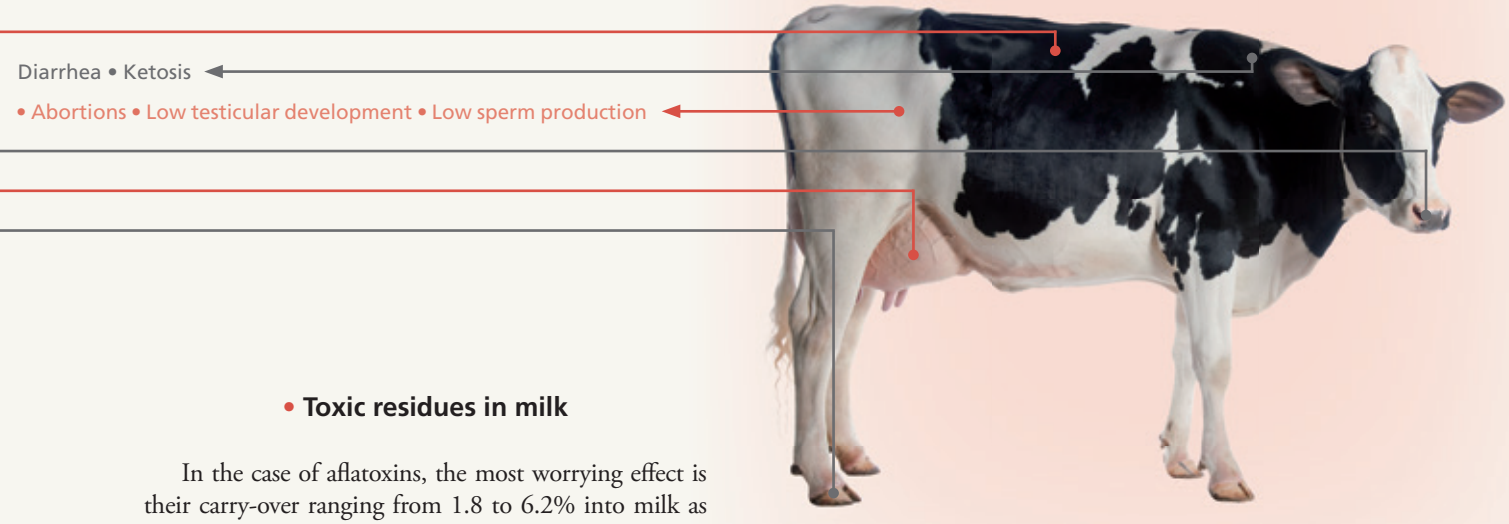
Feedback

The farm started using Mycofix® at 30 g/cow/day. After just 4 days, feed intake was completely re-established. Mycofix® was used for one month (2 weeks at 30 g/cow/day; thereafter at 20 g/cow/day) and parameters such as feed intake and milk production were back to normal.

After a month the farmer decided to stop using Mycofix®. Within 2 days, the same problems resurfaced with a rapid decrease of feed intake. Milk characteristics during the affected period were as follows: SCC: 400.000; Fat: 3.95%; Protein: 3.35%; Lactose: 5.00%; Urea: 24 mg/dl.

Mycofix® was again added to the ration. After a few days, feed intake and milk production were again stabilized. Milk characteristics also returned to normal as follows: SCC: 160.000; Fat: 3.75%; Protein: 3.30%; Lactose: 5.00%; Urea: 24.5 mg/dl.

Figure 1. The most common effects related to the ingestion of feed contaminated with mycotoxins and endotoxins (bacterial toxins) in dairy animals.



- **DON – Deoxynivalenol**
- **ZEN – Zearalenone**
- **AFB_1 – Aflatoxin B_1**
- **T-2 – T-2 Toxin**
- **Ergots – Ergot Alkaloids**
- **Endotoxins**

• Toxic residues in milk

In the case of aflatoxins, the most worrying effect is their carry-over ranging from 1.8 to 6.2% into milk as aflatoxin M_1 (AfM_1). Aflatoxins are considered carcinogenic by the Institute of International Agency for Research on Cancer (IARC).

Case study 3

• Dairy farm Asia, 90 crossbred dairy cows

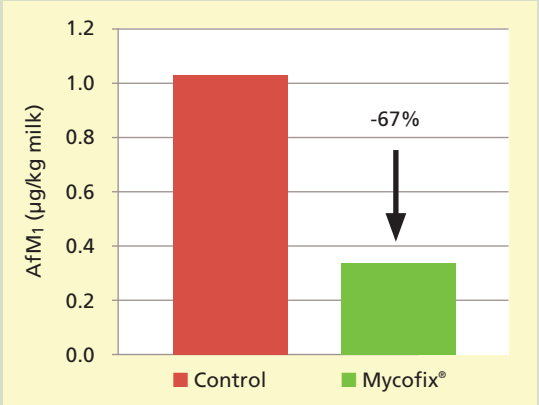
Background

About 1 to 1.2 ppb of aflatoxin M_1 (AfM_1) was found in milk.

Feedback

Mycofix® was supplied at 15 g/cow/day and data was collected over a period of 30 days. AfM_1 content in milk was reduced by 67% on this farm.

Figure 2. AfM_1 decrease in milk after Mycofix® was added to.



Source: Biomin

• Mycotoxins increase the incidence of metabolic problems in dairy animals

Figure 1 provides an overview of the effects of mycotoxins in dairy cattle.

The most common and difficult challenges to identify occur when rations contain low levels of mycotoxins. Subclinical mycotoxicoses decrease profitability by lowering milk production and quality, and increasing veterinary expenses, sometimes with inappropriate therapies. The presence of mycotoxins in feed is very often connected with increased incidences of metabolic disorders such as ketosis, retained placenta, displaced abomasum, mastitis, metritis, lameness, elevated somatic cell count and consequently, decreased milk production (refer to page 6 for case studies 4 and 5).

Multi-mycotoxin strategies

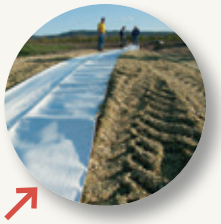
Avoiding mycotoxin formation must begin on the field, should continue in the silage production process and end with correct management of the open silo and feedstuffs.

Most grains and feedstuffs are afflicted by a wide variety of mycotoxin types. The Mycofix® product line of Biomin combines three modes of action—adsorption, biological degradation of non-adsorbable mycotoxins, and protection of the liver and immune system. Accurate feeding of dairy cows in combination with continuous mycotoxin risk management is the key to managing the optimal performance of the livestock business.

Karin Nährer, Product Manager, Mycotoxin Risk Management
Inês Rodrigues, Technical Manager, Asia

Avoiding mycotoxin formation

1. Begin in the field



2. Continue in silage production

3. End with correct management of the open silo and feedstuffs.

Case study 4

• Dairy farm in the Americas, 1,100 Holstein dairy cows

Background

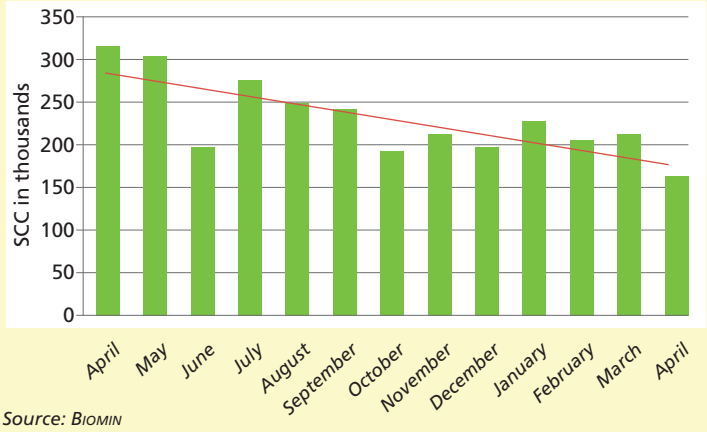
The farm had difficulties with elevated somatic cell counts (SCC) and mycotoxins were suspected to be the causative agent. Mycofix® (30 g/cow/day) was fed and data recorded for one year.

Feedback

Comparing average SCC for the first 2 months of the trial period (most reflective of pre-treatment) with average SCC for the last 2 months, a reduction of approximately 40% can be observed.

Along with the reduction in SCC, the farm found that they had fewer reasons to cull cows from the herd: better production, less mastitis and less breeding issues. This allowed the herd to retain older cows with greater production, and sell younger heifers as an additional source of income.

Figure 3. Somatic cell count reduction over a year with Mycofix®.



Source: Biomin

Case study 5

• Dairy farm in Asia, 600 Holstein dairy cows

Background

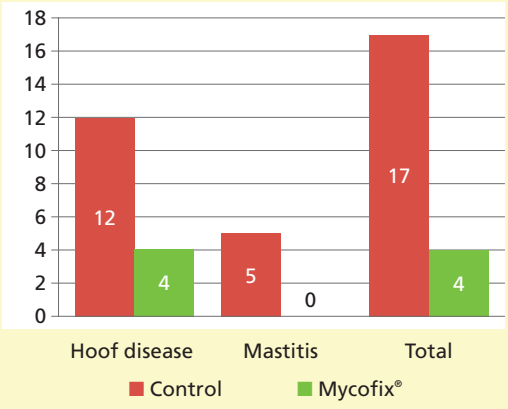
Mycotoxins (mainly ZEN, 200 ppb and DON, 1,200 ppb) were detected in the total mixed ration (TMR).

Feedback

Data were collected over a period of 3 months and compared 2 different treatments (control group without Mycofix® versus trial group with Mycofix® at 2 kg/tonne feed).

After administering Mycofix® in TMR, the health status of animals in the trial group improved with fewer disease incidences.

Figure 4. Disease incidences in the control and trial groups.



Source: Biomin

Data collected worldwide. Special thanks to Doug Taylor, Bryan Miller, Luis Cardo and Shu Guan.

References are available on request.

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Business Director Dairy China

Photo: emesilva/iStockphoto

Part 2

China's rising dairy industry

China's dairy industry is a fast rising one that is developing more rapidly than the local poultry and swine sectors. Today, China is becoming a large and increasingly important global dairy production and trading market.

Unlike the livestock industry, China's dairy industry (farming and dairy production) is concentrated in the northern regions (north, northeast and northwest) of China. Together, these regions account for 83% of the total cattle population, with Inner Mongolia, Heilongjiang and Hebei being the most important provinces. The rest of the country's cattle herds are in central China (11%), and eastern (5%) and southern China (1%) (*Figure 1*).

Backyard farms and cooperatives

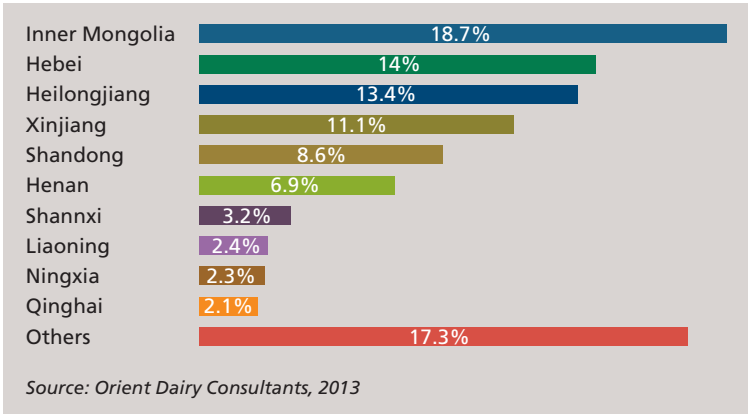
There are three types of dairy farming systems in China: backyard farming, cooperative and commercial farms.

• Backyard farm

Each farmer has up to 20 cows with a component feeding method using compound feeds bought from feed mills, straw, sheep grass and some by-products. Cows are milked at a nearby milking station and the milk yield is

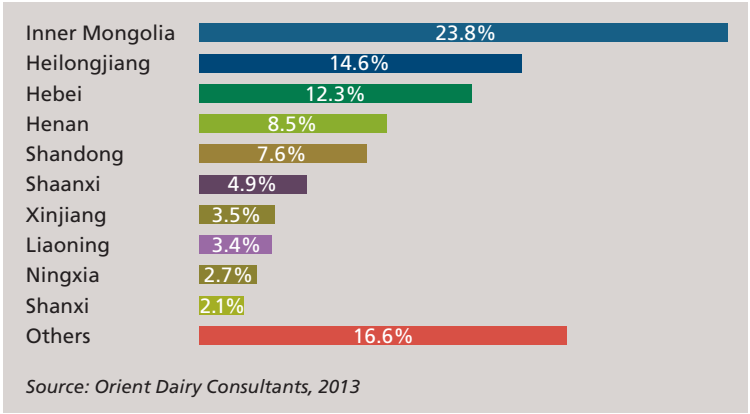
Donald Xu
Business Director Dairy China

Figure 1. Distribution of dairy farms in 2012.



Source: Orient Dairy Consultants, 2013

Figure 2. Distribution of dairy production facilities in 2012.



Source: Orient Dairy Consultants, 2013

about 10-15 kg/cow/day due to poor management.

In general, most farmers are not highly skilled in dairy farming. Technical services are provided by feed mills who sell their feeds to farmers. The milk price of backyard farms is normally US$0.25/kg lower than that of commercial ones.

Figure 3. Map of China showing the provinces.

Macroeconomic trends and the Chinese dairy business,

• Cooperative

The size of cooperatives varies greatly in different provinces, from a few hundred to thousand farms for each cooperative. One cooperative has about 15 individual farmers on average, whose cow numbers vary from 10 to 50. Some owners also have their own cows (normally a few hundred).

All cows at the cooperative are milked at the unit and the milk is contracted with local dairy processors who send a supervisor to inspect the quality of raw milk, mainly for aflatoxin B_1. Each cooperative is managed by the owner who also invests in the facilities at the cooperative. Most of these owners are former milk collectors, collecting raw milk from backyard farmers and selling to dairy processors. Some owners have connections with local governments.

Cooperative owners make money from the price difference (normally $0.08-0.10/kg) between what he receives from the milk processors and what he pays the farmers.

At some cooperatives, individual farmers have the right to decide which feeds to buy, while other cooperatives have a centralized feed purchasing system. In the latter, the cooperative owner buys the feed and sells it to farmers. The farmers do not pay for the feed immediately; instead, this cost is later deducted from the income that the farmer receives from selling his milk to the owner every month.

The average milk production at cooperatives is about 15-20 kg/cow/day, which is half to one-third that of commercial farms. Milk prices are also about $0.15/kg lower.

The majority of cooperatives rely on a component feeding method with concentrates and compounds bought from feed mills. Local alfalfa hay is one of many feed ingredients used. Farmers

policy support ensure the long-term development of a trend which will continue for at least a decade.

may also instead choose to feed their cattle corn stover silage (without grain), DDGS, rapeseed meal and wheat straw. Feed additives are seldom used in many cases. Technical services are provided by feed mills that sell their feeds to farmers.

• Commercial farms

Commercial dairy farms are classified as small, medium and large respectively. The definition of size varies across the different provinces and regions. Farms with fewer than 500 cows are usually considered small, those with 500 to 1,000 cows are medium, while those with over 1,000 cows are large.

Citing figures from the China Dairy Yearbook 2013, there are about 60 farms with over 10,000 cows on a single farm. The 33 largest dairy integrators have 340 farms with a total number of 800,000 dairy cows while the top 100 dairy processors own about 240 dairy farms each. The cattle population and distribution of small-to-medium farms is shown in *Table 1*.

The majority of commercial farms use a total mixed ration (TMR) which normally comprises concentrates/compounds, alfalfa hay (local or imported), corn silage (with grain) or corn stover (without grain), DDGS, whole cotton seeds, soybean meal, rapeseed meal extruded soybean, sheep grass, wheat straw, wheat bran, by-products and other additives.

Milk production levels also differ among different commercial farms ranging from 6,000 to 11,000 kg/cow/year. Most small-to-medium farms buy concentrates and/or compound feeds from feed mills and mix their own rations based on formulations developed by a nutritional consultant. Most large farms have their own nutritionists who develop the formulations and mix their own feeds, buying only premixes. In 2013, the average milk price of large farms ranged from $0.75 to 0.80/kg, with the top producing ones commanding a price of $0.95/kg milk.

Rabobank has estimated that by 2016, the milk supply from commercial farms will increase to 30-35% of all domestic production, from the current level of less than 20%, while the contribution from small farms will drop from the current level of 60% to 40%.

Table 1. Cattle population and distribution according to farm size.

Head of cow per farm	Total cattle population on such farms	No. of farms
500-999	1.4 million	2,065
>1,000	2.1 million	1,016

Source: China Dairy Yearbook, 2013

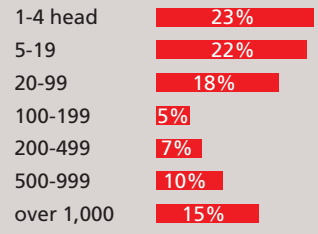
According to the Ministry of Agriculture (MOA), farms and cooperatives sized over 100 cows accounted for 37% of the total cow population in 2103 compared with that of 19.54% in 2008. This percentage will increase to up to 40% by the end of 2014 (*Figure 4*).

Government support

Since 2008, the Chinese government has encouraged the intensification and consolidation of dairy the industry through a policy of tax incentives and subsidies. In 2013, the central government allocated a budget of $161.3 million for farm constructions, $42 million for genetic improvement, $6.12 million for dairy herd improvement, and $85 million for alfalfa production respectively.

Urbanization and rising incomes, the newly released policy of two children per family (towards population growth), modernization of dairy farms and the increase in dairy product consumption have all stimulated dairy demand and the construction of large commercial dairy farms to meet these changes and new market needs.

Figure 4. Dairy farm size and percentage in 2013.



Source: Orient Dairy Consultants, 2013

China is rising to become one of the most important players in the world dairy industry. Macroeconomic trends and policy support ensure the long-term development of the Chinese dairy business, a trend which experts expect to continue for at least a decade.

Mycofix®

Proven protection

… throughout the entire production cycle.

Mycofix® is **the** solution for mycotoxin risk management.

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*Regulation (EU) No 1060/2013

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