From the field to the cow's health, be careful of mycotoxins in the forage!

By Julia Laurain, dairy nutrition specialist, Olmix, France.

Dairy cows are ruminants; this is why more than 60% of their nutrients come from forages. Milk productivity has been largely improved during recent years thanks to higher nutritive values, increased digestibility, intake and efficiency of forages.

As a consequence, the trend has been to increase the use of corn silage due to its high and uniform nutritional quality (1.5 MCal/kg DM in average), ease of cultivation and high yields (up to three times more tons of DM/ha than grass).

Nevertheless, corn silage nutrient quality is variable from one year to another depending on the climate, but growth conditions also alter the levels of toxins contamination in the plant.

When, where and why

In the field, forages are naturally in contact with various fungi, the most frequent one is Fusarium. Fusariose is a common disease on cereals mainly affecting the cob and often caused by F. graminearum, F. culmorum, F. poae and F. avenaceum.

As for all fungi, Fusarium growth depends on moisture levels (22-25% humidity in the plant) and temperature (>15°C). Some cultivation methods have been identified for their impact on Fusarium development, like crop rotation.

Growing corn grains after corn (grains or silage) increase the risk of DON development in the crop, as the crop wastes are also contaminated in Fusarium and carry the fungi from one year to another. That is also why no-till farming highly increases the risk of Fusarium development as crop wastes will not be ploughed under, remaining on the field's surface and contaminating the next crop.

Selecting varieties resistant to Fusarium helps to control the risk on crop, but this criterion is not yet well documented on corn seeds. Field application of fungicides is not common on corn due to the height of the plants and as a consequence the risk of Fusarium development on corn is higher than on other cereals.

The fungi itself is not a threat to the animal, but in stress conditions Fusarium produce mycotoxins. All factors that alter the fungal development can provoke the production of these secondary metabolites: mycotoxins.

For instance, it was observed that Fusarium proliferates between 25 and 30°C without producing any mycotoxins, whereas when the temperature drops to 0°C one part of the fungi will produce high levels of mycotoxins. Changes in humidity can also affect the production of mycotoxins.

As a consequence, forages are often contaminated by Fusarium mycotoxins like trichothecenes (DON), zearalenone and fumonisins, with variable level of contamination depending on climate, cultivation methods, etc. The quality of silage preservation (anaerobia, T°C, Aw, length of preservation) will also impact the development of Fusarium and storage moulds that can produce aflatoxins and ochratoxins under specific conditions. Worldwide, approximately 25% of crops are affected by mycotoxins annually (CAST, 1989).

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Fig. 1. Milk performance in a herd of 290 Holstein cows (Segovia, Spain, December 2011 until June 2012).

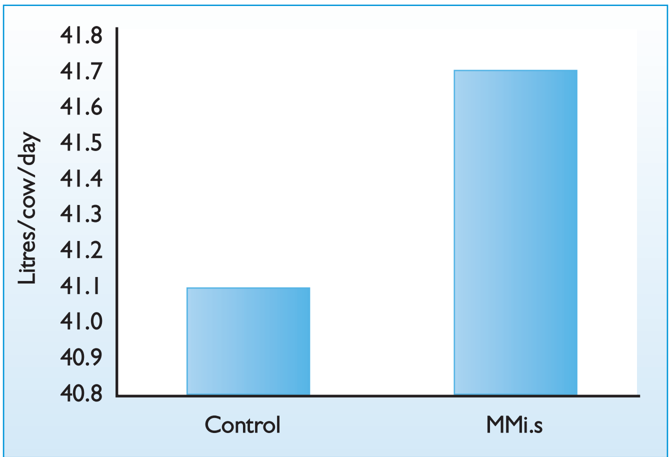
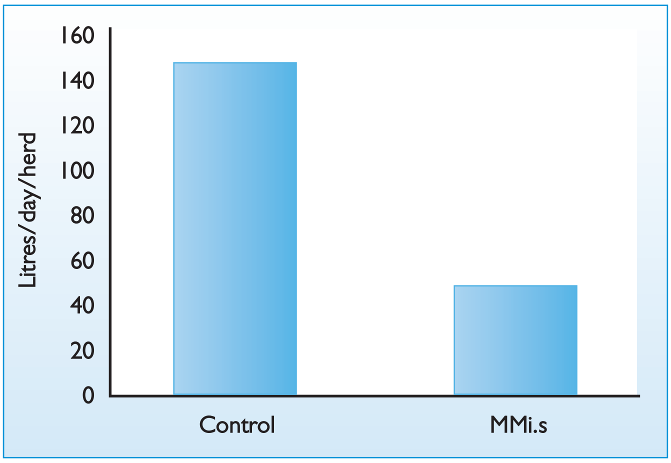


Fig. 2. Culled milk (milk with high conductivity, mastitis or treated with antibiotics).



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According to a German survey on 196 corn silage samples, more than half of the corn silage samples were significantly contaminated in DON : 59% > 0,300mg/kg; 9.2% > 2mg/kg ; 2.6% > 5mg/kg.

In 1998, Withlow analysed the occurrence of mycotoxins in dairy cows diets in North Carolina over a nine year period.

The incidence of DON in silage was 66% (mean value 1.991mg/kg) and the incidence of zearalenone in silage samples was 30% (mean value 0.525mg/kg).

Mycotoxin occurrence and concentration in forages are variable from year to year because of the annual variation in weather conditions and plant stresses known to affect mycotoxins formation.

The cow and mycotoxins

For a long time, it was accepted that rumen microbes can detoxify mycotoxins. In some studies with dairy cows, scientists stated that the capacity for mycotoxin detoxification in the dairy cow rumen is lower than believed.

Heinz-Kiessling showed that the efficacy of detoxification is not the same for all mycotoxins, DAS, T2, ochratoxin and zearalenone are partially converted, whereas in this study no degradation was noticed for DON and aflatoxin B1.

Other studies measured a partial degradation of DON into DOM-1, a less toxic form. Heinz-Kiessling also showed that the decrease of zearalenone was the result of a reduction to zearalenol, and mainly (90%) to α-zearalenol, which is three to four times more oestrogenic than the parent compound.

Fumonisins are not altered in the rumen. Heinz-Kiessling proved that protozoa are invariably more active than bacteria in the detoxification process, but they are also more sensitive to mycotoxins than bacteria.

In a German study they investigated the ruminal patterns influenced by the proportion of concentrate in the feed ration, with and without Fusarium toxin-contamination of the diet.

Feeding a total mixed ration with 50% concentrate and a mean DON concentration of 5.3mg/kg dry matter to 13 German Holstein cows in early lactation (Myco group) resulted in alterations in the ruminal fermentation patterns: alteration of the volatile fatty acids balance followed by drop of pH values, critical for developing subacute acidosis.

This could indicate a switch in the microbial community due to direct effects and/or indirect effects of the Fusarium infection on ruminal microbes. Fusarium mycotoxins exert their effects through three primary mechanisms in dairy cattle.

The first impact of mycotoxins in animal health is the increase of immunosuppression, described by Surai and Dvorska in 2005. In 2009, Koroteleva et al, concluded that Fusarium mycotoxins can decrease some cellular aspects of immune function in dairy cattle, while stimulating primary humoral response to specific antigens.

The second impact of Fusarium mycotoxins (mainly trichothecenes), is a reduction in amount of nutrients available for use by the animal due to lower feed intake and by irritation of the digestive tract (reduction in villi height).

The third impact of Fusarium mycotoxins is the direct effect of zearalenone and its metabolites on the reproductive performance due to its oestrogenic effects.

To the dairy farmer, the clinical or subclinical losses in performances, the increase in incidence of disease and the reduced reproductive performance are of great economic importance. As a consequence, it is very important to detect and protect cows from mycotoxin contamination in order to avoid this economic loss.

Detection in forage

Mycotoxin detection in dairy cattle is not easy as mycotoxin contamination provoke troubles that are common and also due to other issues in the herds.

In order to help farmers to detect mycotoxin contamination in the herd, Olmix provides a simple online tool called the Mycotoxins Evaluator.

With this tool the probability of having mycotoxins in the dairy cow's diet can be calculated before analysing the diet.

How to react

The use of mycotoxin binders in the cow's diet in combination with optimum farm management practices is the only possible method to reduce mycotoxins and their impact on dairy performances. The choice of an effective binder is a key factor in this process and must be done following strict efficiency criteria and demanding performance results.

In this domain, Olmix is a specialist, as they have developed new technologies to provide the largest spectrum of mycotoxin adsorption in a microgranulated form to optimise protection of the cows, in a product called MMi.S.

All over the world MMi.S proves its efficiency in the protection of dairy cows for better performances. For instance, in the latest MMi.s test carried out in Spain in a high milking herd (Fig. 1), MMi.S permits a significant reduction in the separated milk (Fig. 2) without altering milk production (+0.6 litres). ■

References are available from the author on request