Good Management Practices to Reduce Aflatoxin M1 in Milk

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Aflatoxins are secondary metabolites of *Aspergillus Flavus* and *Paraliticus* fungi and they are produced in regions where climate is hot and humid like in tropical and sub-tropical areas.
There are three main strategies that can be applied to manage and counteract M1 presence in milk and each of them can have different degrees of efficiency, economical convenience and practical applicability.

These strategies are:
1) Prevention pre and post harvesting
2) Decontamination
3) Adsorbtion

All these strategies can be put on place together after economical and efficacy evaluation and rely on fundamental steps of aflatoxins development and contamination. Farmers should combine two or more in the light of reduction M1 in milk.

Prevention

As the appearance of M1 in milk is real, fast and consistent if Aflatoxins B and G are present in the raw materials, the first step to control M1 contamination is the selection of non or low contaminated raw materials.
In fact a part from balancing for covering the rumen and ruminants need in energy, protein and minerals the composition of ration should combine raw materials also considering the final level of Afs reaching every day "the mouth of cows".
Farmers can utilize feedstuffs purchased or self-produced and on both a careful evaluation should be done considering an 'action levels' for aflatoxin in all feed ingredients (Table 1).

Table 1: Legislated levels of aflatoxins and AfM_1 in the European Union (EU) (based on Commission Regulation No. 1881/2006 and Directive 2002/32/EC) and in the United States of America (USA) (based on US Food and Drug Administration).

	Aflatoxin M_1 (ppb)	
Raw milk, heat-treated and milk for the manufacture of milk-based products	US: 0.50	EU: 0.050
USA	**Sum of AfB_1, AfB_2, AfG_1 and AfG_2**	
	(ppb)	
Corn, corn products, cottonseed meal, and other animal feeds and feed ingredients intended for dairy animals	20	
EU	**Aflatoxin B1 (88% DM) (ppb)**	
Feeding stuffs for dairy	5	

For feedstuffs that can be produced in the farm (mainly corn and cereals), the suggestion is to minimize the stress factors to the plants during cultivation and harvesting (*prevention pre harvesting*). Among different stressors we should be very careful about: drought, plant density, nutritional and fertilizing deficiencies, damages to the plants and seeds during the harvest and storage.
For feedstuffs that must be purchased outside the farm a good rule of thumb is to be aware which are the ones bearing the main risk to be contaminated and check them. To select "safe" raw materials proper analyses (good sampling procedures and suitable reliable methods)

should be applied. Although sometimes difficult to obtain, tools like certified purchase of raw materials for aflatoxins content could be an additional value and they are strongly suggested.
Often at the moment of preparing TMR risky raw materials can be present and we have to use them managing the aflatoxin issue. If this is the situation the first suggestion for farmers is to limit their use, when possible, to the minimum amount.

A second potential period for Aspergillus to growth and aflatoxins production is during storage.
Farmers need to store feedstuffs at risk in a way *Aspergillus spp* could no growth and develop aflatoxins (*prevention post harvesting*). A careful control of the humidity of purchased cereals and the use of preservative when dry mater is below 88% can be strongly advised. Organic acids in un-dissociated form can be used on stored grain to decrease pH and prevent fungi further development.

Decontamination
Ozonization and ammoniation of contaminated feedstuffs have be shown as promising treatments for AFB 1 contaminated corn and cottonseed meal because it can be used in large batches of product (CAST, 2003). However, both methods are time consuming and economically impractical. Moreover, they cannot be applied on preserved feedstuffs like silage. Also microwave, mechanical separation and solvent extraction can have some efficacy on raw materials but all these treatments are often considered cost prohibitive and not enforceable for most practical applications.

Adsorbtion
Based on above reports, the problem of M1 in milk can be quite difficult to manage. Both prevention and decontamination strategies can have limited efficacy notwithstanding the farmers' effort. External factors difficult to manage (environmental, commercial etc…) can jeopardize previous actions. Among different constraints the main are:

- Fast, consistent, compulsory appearance of M1 in milk as soon as aflatoxins are present in feedstuffs;
- Analyses that need good representative sampling and proper analytical tools;
- Need to use the "in farm produced" feedstuffs that are contaminated due to adverse climatic season;
- Variable quality and contamination of feed stuffs purchased;
- Variation in climatic conditions.

Moreover, every strategy implemented must be efficient and in the same time economically acceptable.
Adsorption of aflatoxins with specific, independently validated and safe product is an efficacious and affordable way completely in the hand of the farmers.
Bentonites are very active in adsorbing aflatoxins but not all the sources of bentonite are the same. A good adsorbent should have high adsorption capacity, strong binding without any reversibility, high affinity for aflatoxins but not for essential nutrients like vitamins. Besides, it must be without any toxicity (free from undesirable substances like dioxins).
Bentonite that is inside Mycofix Plus (EC number 1m588) is fulfilling the strict and selective EU requirements (Regulation EU 1060/2013) as established by European Union Reference Laboratory (EURL). These are the most advanced criteria for Mycotoxin B1 binders. Products that do not comply with these rules cannot be consider efficient. Many of the most common agents making aflatoxin-binding claims when tested using EURL methods do not achieve the 90% aflatoxins adsorbtion required to claim this effect.
This independent validation of bentonite in Mycofix Plus is the best warranty of efficacy and safety so at the end of its added value.

The strong activity of Mycofix Plus is well documented also in practical condition. In high-contaminated situation, Mycofix Plus consistently reduced the quantity of M1 in milk (Pietri 2009).
Another advantage that farmers can benefit from Biomin Technical Service is the suggestion of effective dosage of Mycofix Plus depending on M1 in milk and the effects of B1 seen at the farm level. Excretion in fact depends also from the type of diet and transit time. If we apply the right quantities of Mycofix Plus we can permit farmers to face situation of low, medium and high contamination (Table 2).

Table 2

Risk levels of Mycotoxins	Low	Medium	High	Method of control
Aflatoxin B1 (Total µg/cow/day) Dairy Cow (EU limit 0,05 µg Afla M1/l milk) (FDA limit 0,50 µg Afla M1/l milk)	< 50	50-55	>65 - 80	Adsorbtion

As additional value and benefit Mycofix Plus guarantees a proven effect on a broader range of mycotoxins other than aflatoxins thanks to its Biological constituent and BBSH 797.
Moreover, the presence of Phytogenic substances and Phycophytic constituents ensure powerful tools to mitigates the adverse effect caused by mycotoxins and other inflammatory and hepatotoxic agents and to strength the animal immune system.
<u>False myths and don'ts</u>
Considering aflatoxins in feed and milk there are some myths and reality scenarios.
The absolute biological truth is that the only way to decrease M1 in milk is to decrease the quantity of Aflatoxins (B1, B2, G1 and G2) adsorbed. In fact if aflatoxins are present in feedstuffs we can expect M1 rise in milk. Milk with urine is the main route of M1 excretion in dairy cows.
Regarding others practical issue is established that:

- There is no benefit from pasteurization and freezing milk in the attempt to decrease M1. A report from U.S. FDA indicated that AFM1 was stable for 18 days when milk was pasteurized and for 120 days when milk was frozen at -18o C (Stoloff et al., 1975).
- Rumen do not degrade completely aflatoxins. Since the rumen degradation of the AFB1 is considered a less important pathway and the produced metabolite (M1) has the same toxicity of the parent toxin, it may be concluded that ruminants are not so efficient against aflatoxins. However keeping efficient rumen function is an additional tools for mycotoxin management as rumen can degrade other mycotoxins.
- Dilution of contaminated raw materials and feedstuffs can help to decrease quantities of aflatoxins but we need to carefully know the level of all raw materials composing the ration. The list raw materials used for TMR and potentially at risk of contamination is quite extensive.
- Adsorbent agent decrease fertility on dairy cows. Yes if the substance or blend of minerals are not well balanced between the strength of adsorption and the specificity. Mycofix Plus is tested for not adsorbing minerals and vitamins. Usually fertility indices improve using Mycofix Plus.
- The cheapest adsorbent agent is the best economical choice. This is not true as the payback of one product depends mainly on the efficacy to solve the problem without any drawbacks (decrease fertility, contaminants like dioxins, release aflatoxins in the hindgut).