



RISE Program

Risk Impact Strategy Evaluation

Mitigation of chronic exposure to emerging mycotoxins in dairy farming

Country:
South Europe

Type of farm:
dairy farm

Analysed animals:
fresh and mid late production cow

Summary of the case

Risk

TMR:

- Deoxynivalenol
- Fumonisin

Blood:

- Beauvericin
- Enniatin B
- Enniatin B1
- Tenuazonic acid

Impact

Symptoms:

- High SCC (>280,000)
- Cystic ovarian (>1.5)
- Manure inconsistency

Strategy

Escent® S (25 g/animal/day) introduction

Biomonitoring 2 months after Escent® S introduction

Feces analysis

Evaluation

Mycotoxins removed in blood

SCC reduction (<150,000)

Improvement of the cystic ovarian (<0.8)

Increase in available energy

Risk

Severe symptoms of unknown origin were reducing the performance of cows on a dairy farm. Producers made the decision to rely on the RISE® program as mycotoxins were suspected of causing the problems. Therefore, TMR (16 mycotoxins) and blood (36 mycotoxin biomarkers) analyses were performed using LC-MS/MS to elucidate actual mycotoxin exposure. Blood samples were collected using FTA cards (figure 1). The results revealed exposure to six different mycotoxins: two mycotoxins in the TMR (deoxynivalenol and fumonisins) and four emerging mycotoxins in blood (beauvericin, enniatin B, enniatin B1 and tenuazonic acid) (table 1).

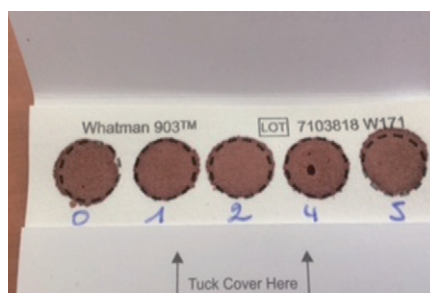


Fig 1. Blood samples are collected using FTA cards. Only 60 µL of blood per animal are necessary to quantify 36 mycotoxin biomarkers.



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	Mycotoxin	Prevalence (%)	Concentration (ppb)
TMR	Deoxynivalenol	100	44
	Fumonisin	100	682
BLOOD	Beauvericin	40	Detected
	Enniatin B	100	Detected
	Enniatin B1	100	Detected
	Tenuazonic acid	60	Detected
TOTAL number of mycotoxins			6

Color scale with risk levels



Table 1. Heatmap summarizing mycotoxins levels detected in TMR and blood following Innovad® risk level.

The great exposure to emerging mycotoxins, such as enniatins and tenuazonic acid, was expected because scientific raw materials/feed surveys and the [Innovad biomonitoring program have confirmed](#) that **emerging mycotoxins are more prevalent than legislated mycotoxins**.

Impact

The risk identified with exposure to six different mycotoxins could be the main reason for the symptoms suffered. First, mycotoxin exposure has been correlated with an increase in somatic cell count (SCC) as mycotoxins reduce the immune response. Thus, co-exposure to six different mycotoxins shrank the milk quality and increased the SCC (>280,000).

Zearalenone is widely known to be an estrogenic mycotoxin. Recently it has been scientifically demonstrated that other mycotoxins, such as enniatins and beauvericin, can also be toxic for the reproductive system ([Chiminelli et al., 2022](#)). For example, enniatins and beauvericin impair ovarian function. Therefore, the detected chronic co-exposure to three of these mycotoxins (enniatin B, enniatin B1 and beauvericin) could be related to the identified reproductive problems (cystic ovaries, >1.5).

Symptoms
✓ High somatic cell count (>280,000)
✓ Cystic ovaries (>1.5)
✓ Manure inconsistency

Finally, the inconsistency of the manure was showing digestive problems, but all identified mycotoxins in the analyses cause alterations in ruminal fermentation and toxicity in intestinal tissues. Deoxynivalenol is known to be highly toxic for the intestinal cells, but different studies have concluded that enniatins and beauvericin are as toxic as deoxynivalenol to intestinal cells. Moreover, it is necessary to remind that the multi-mycotoxin exposure has a synergistic and additive negative effect and studied animals were exposed to 6 different mycotoxins.

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Strategy

After elucidating the impact of the mycotoxin exposure, the following step was to build a strategy.

Typically, strategy followed in RISE program has two different parts:

- **Mitigation of the risk:** establishment of measures to reduce the exposure and the impact of mycotoxins and support animals to combat stress
- **Monitoring the risk:** build a plan to assess periodically the real mycotoxin threat combining TMR, blood analysis and feces.

To mitigate risk, Escent® S (25 g/animal/day), a technology to detoxify and reduce stress impact, was introduced. On the other hand, Innovad established a monitoring plan through Myco-Marker® service. Biomonitoring plan consisted in the collection of 5 blood (5 animals) + 5 feces (5 animals) + TMR samples two months later after Escent® S introduction (25 g/animal/day) (figure 2). Blood samples (collected through FTA cards) were analysed for 36 different mycotoxin biomarkers, while TMR samples were analysed for 16 key different mycotoxins. Feces were analysed through NIR spectroscopy.

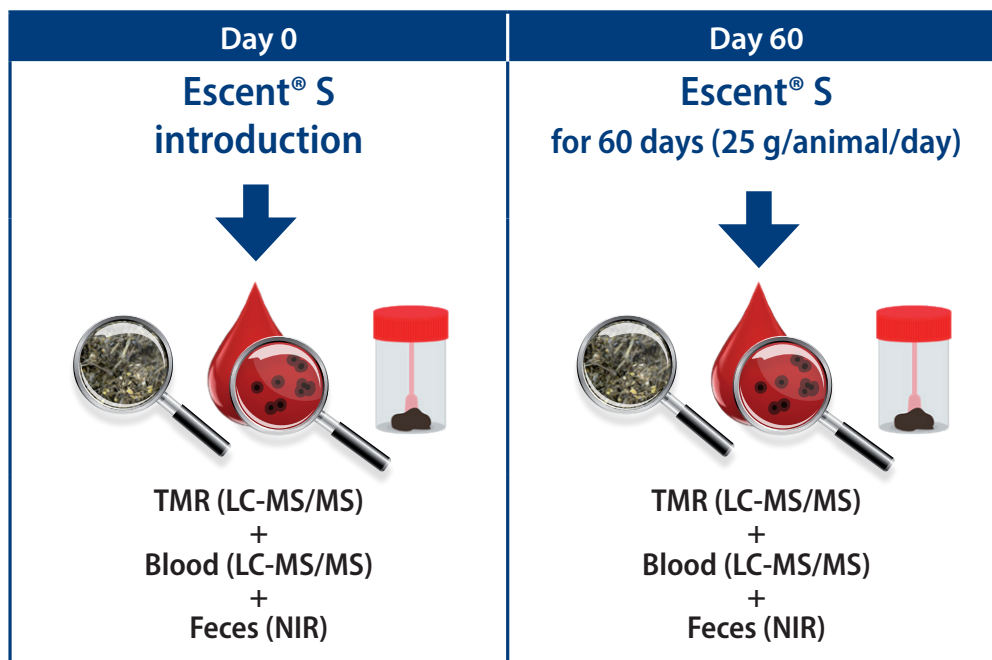


Figure 2. Sample collection program to monitor risk as part of the strategy in the RISE program. TMR, blood (5 animals) and feces (5 animals) from the farm were collected before and after Escent® S application (2 months).



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Evaluation

Samples collected after using Escent® S for 60 days were evaluated to measure the efficacy of RISE. TMR analysis detected exposure to two mycotoxins (deoxynivalenol and fumonisins) as before the introduction of Escent® S. However, TMR sample collected later (after two months under Escent® S) had higher mycotoxin concentrations, approximately x10 (deoxynivalenol) and x2 (fumonisins) times higher (table 2). The higher concentration of mycotoxins in the TMR indicated that studied animals were exposed to a higher mycotoxin risk after the introduction of Escent® S. In opposition, **no mycotoxins were detected in blood after 60 days consuming Escent® S.**

	Before Escent® S introduction	After Escent® S introduction (25 g/animal/day)
TMR	Deoxynivalenol (44 ppb)	Deoxynivalenol (459)
	Fumonisin (682 ppb)	Fumonisin (1,320)
BLOOD	Beauvericin	—
	Enniatin B	
	Enniatin B1	
	Tenuazonic acid	
TOTAL number of mycotoxins	6	2

Table 2. Heatmap with the mycotoxin results in the TMR and in the blood and total number of mycotoxins detected before and after using Escent® S (25 g/animal/day) for 60 days.

The removal of mycotoxins from the blood stream is highly important as it confirms that Escent® S can reduce the systemic exposure to mycotoxins (including the emerging ones) and protect the animals from them. It is worth remembering that **Escent® S is the only technology that has scientifically proven the ability to significantly reduce mycotoxins from biological fluids under a multi-mycotoxin exposure scenario.**

Lowering systemic exposure to mycotoxins + yeast compounds (contained in Escent® S) helped to improve animal health status and reduce infections. Consequently, SCC decreased from >280,000 to <150,000 and milk quality improved.

Moreover, as exposure to enniatin B, enniatin B1 and beauvericin was stopped, cystic ovaries were reduced, from 1.5 to 0.8, and reproductive performance improved.

Finally, fecal analysis discovered an increase in total tract digestibility of starch (+2.7%) and neutral detergent fiber (NDF) (+3.8%) after using Escent® S for 2 months (table 3). The increase of total tract digestibility is important as several studies have shown strong correlations between total tract organic matter digestibility and energy corrected milk yield. In this way, some approximations concluded that each percentage unit increase in total starch digestibility provides enough energy for ~ 317 g of milk, and a 2 to 3 percentage unit increase in NDF digestibility provides enough energy for ~ 453 g. of milk ([Clayton Stoffel Progressive Dairy, 2022](#)). Considering the increase in total digestibility of starch (+2.7 percentage unit) and NDF (+3.8 percentage unit) detected in the feces analysis, the available energy would increase by approximately 1,310 g of milk after two months using Escent® S (table 3).

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Evaluation

	Digestibility of starch	Digestibility of NDF
Before Escent® S	95.9%	35.0%
After Escent® S (25 g/animal/day)	98.6%	38.8%
Increase	2.7%	3.8%



**Total increase of energy available
for ~ 1,310 g of milk**

Table 3. Digestibility of starch (%) and NDF (%) before and after using Escent® S (25 g/animal/day) for 60 days. An increase in the digestibility of starch and NDF produces energy available to produce milk.

All in all, the establishment of RISE program successfully reduced the mycotoxin exposure and improved animal health status and performance. Although animals were initially exposed to 6 different mycotoxins, Escent® S reduced the exposure to them and protected the animals. The biomonitoring assessment confirmed the effectivity of the program. Whilst before Escent® S introduction 6 mycotoxins (2 TMR + 4 blood) were detected, only 2 mycotoxins (2 TMR + 0 blood) could be identified after 60 days using Escent® S. Exposure to 2 mycotoxins at low concentration is a low risk if it is compared with the blood and TMR survey conducted by Innovad where 57% of the cases had exposure to 6 or more mycotoxins (figure 3). The large efficacy of RISE program was translated into a better performance (reduced SCC and improved digestive efficiency) and health status (improvement of the reproductive system).

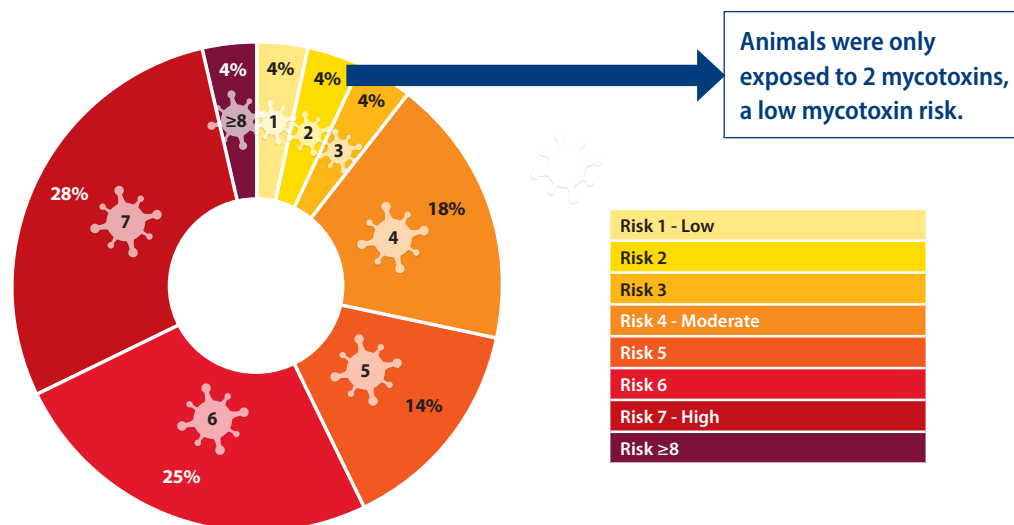


Figure 3. Distribution of the total number of mycotoxins per case in the TMR and blood survey performed by Innovad. Two months after using Escent® S, animals were only exposed to two mycotoxins.

Evaluation

Main conclusions

- Livestock are highly exposed to emerging mycotoxins and these mycotoxins are as toxic as legislated mycotoxins: reducing performance, damaging intestinal tract, and impairing reproductive system.
- RISE® program reduced mycotoxin risk and Escent® S confirmed the large efficacy to remove mycotoxins levels (even the emerging ones) in blood.
- Escent® S (25 g/animal/day) improved the health status from the cow (reduced cystic ovaries) and improved the performance (reduced SCC and increase in available energy).
- RISE® program offers, for the first time, the possibility to evaluate the efficacy of the mycotoxin control strategy specifically for each farm in relation to live performance, combining analysis from TMR and blood. The data generated provides superior diagnostics and informed decision making.

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[Check here previous RISE case of the month >>](#)

1. February 2022: swine (sows)

2. April 2022: poultry (layers)