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Silage could be a way to detoxify maize contaminated by *Fusarium* toxins

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INTRODUCTION

Under unfavourable climatic conditions, *Fusarium spp.* can contaminate maize plants in the field and produce toxins that are present at the time of ensiling. Economic losses that result from *Fusarium* contamination include poor grain quality, lower crop yields and reduced animal performances. In spite of the wide utilization of maize silage, there is scarce information on the stability of *Fusarium* toxins. The objective of this work was to study the stability of four major *Fusarium* toxins: deoxynivalenol (DON), fumonisin B1 and B2 (FB1, FB2) and zearalenone (ZEA) in whole plant corn (WPC) silage stored under different conditions.

MATERIALS AND METHODS

- Stability of *Fusarium* toxins was tested over two consecutive years on the same variety of WPC, cultivar *Anjou 265*, ensiled at low and high dry matter (DM). In addition to the effect of DM, the experimental procedure tested the effect of temperature and length of storage on toxins' stability.

- Year 1: WPC was harvested at 29 and 38% DM, ensiled in 2 different silos: big silos (Si-2000L, n=4, 2 per DM) and in a selected mini silo model (MiSi-20L, n=18) and stored for 11 months at 3 temperatures (ambient, 15 and 30 °C), but only at ambient temperature for Si-2000L.

- In year 2, only MiSi-20L were used. WPC harvested at 28 and 42% DM was ensiled and stored at two temperatures (15 and 30 °C) during 3 and 6 months.

- The *Fusarium* toxins-contaminated corn (4-5 g) were placed individually into 10 x 5 cm nylon bags (SEFAR, NITEX, 200 µm porosity, Germany), spread out in a fine layer, and introduced at different depths in the silos.

- Fusarium* toxins analysis were done by HPLC and diode array or fluorescence detection.

Table 1: Stability of DON, FB1, FB2 and ZEA in WPC ensiled at two DM contents in 20-liter and 2000-liter model silos stored at ambient temperature for 11 months (*year 1*)

Silo	DM (%) ^a	<i>Fusarium</i> toxin remained/initial (C/C0, %) ^b			
		DON	FB1	FB2	ZEA
Si-20L	28	0.0 ± 0.0	9.7 ± 2.3	35.4 ± 2.7	60.9 ± 11.0
	38	0.0 ± 0.0	11.4 ± 1.5	27.3 ± 0.3	51.6 ± 7.6
Si-2000L	28	0.0 ± 0.0	9.1 ± 1.2	21.4 ± 9.5	65.6 ± 6.6
	38	0.0 ± 0.0	12.0 ± 6.5	34.4 ± 25.4	50.9 ± 3.6
Effect of type of silo		NS	NS	NS	P<0.05
Effect of dry matter		NS	NS	NS	NS

^a Dry matter at ensiling time; ^b Mean ± SD, n=3

Table 2: Stability of DON, FB1, FB2 and ZEA in WPC ensiled at two dry matter contents in 20-liter model silos stored for 3 and 6 months (*year 2*)

Dry matter ^a (%)	Storage (month)	Temperature (°C)	<i>Fusarium</i> toxin remained/initial (C/C0, %) ^b			
			DON	FB1	FB2	ZEA
28	3	30	4.0 ± 1.7	11.1 ± 3.0	37.8 ± 6.5	60.0 ± 20.4
		15	2.4 ± 0.6	16.3 ± 7.7	54.7 ± 14.6	56.7 ± 16.6
		6	30	0.0 ± 0.0	8.3 ± 3.3	18.5 ± 2.4
	42	3	15	0.0 ± 0.0	11.5 ± 2.4	73.8 ± 7.0
30			16.6 ± 3.0	88.7 ± 4.3	76.7 ± 11.2	73.8 ± 7.5
15			15.1 ± 1.3	72.2 ± 1.6	90.3 ± 3.8	79.0 ± 7.8
6		30	5.2 ± 0.0	54.4 ± 12.0	80.6 ± 11.5	78.1 ± 0.3
	15	7.4 ± 4.5	62.2 ± 15.7	92.0 ± 6.9	94.5 ± 1.9	
Effect of dry matter			<0.001	<0.001	<0.001	<0.001
Effect of storage length			<0.001	<0.001	NS	NS
Effect of temperature			NS	NS	<0.01	NS

^a Dry matter at ensiling time; ^b Mean ± SD, n=3

RESULTS

- All silages obtained from the different treatments were of good quality and did not differ from each other. No mould growth was visible in any of the mini silos, and the fermentative parameters were within normal ranges.

- The concentration of all *Fusarium* toxins decreased upon ensiling ($P < 0.001$). Increasing the length of storage and ensiling with low DM resulted in a higher rate of toxin disappearance, particularly for the water-soluble toxins DON and FB1. Toxin disappearance ranged from 50% for ZEA up to 100% for DON. In contrast, temperature did not have any effect on stability ($P > 0.05$) (Table 1 and 2).

CONCLUSIONS

- These results indicate that low DM at ensiling as well as a prolonged storage could be a practical way to reduce or eliminate some *Fusarium* toxins in contaminated silages.

- The water-soluble *Fusarium* toxins (DON and FB1) which are the most common and most toxic *Fusarium* metabolites, appear to be largely eliminated after a relatively short storage time of the silage.

- Further studies are needed to elucidate whether these toxins are actually degraded in the silage and the proportion that can be eventually eliminated in the fermentation juice.

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