Mycotoxin production in Tifton 85 hay dried in the sun and at shed

L. E. Taffarel[1], E.E. Mesquita[1], N.T.E. de Oliveira[1], P.B. Costa[1], J. Gris[2], J.A.G.Gonçalves[2]
[1]*State University of West of Paraná, Center for Agricultural Sciences, Centro de Ciências Agrárias, Marechal Cândido Rondon, Paraná, Brazil*
[2]*Vets - Nutrition Coordinators of pork and cattle at Nutrifarma Company – Maripá – Paraná - Brazil*
Email: loreno.taffarel@gmail.com

Introduction This research was carried out in a permanent field in two harvesting periods and in two different agricultural practices. It was identified several species of fungi (14 *Aspergillus*, 9 *Fusarium* and 2 *Penicillium* species) and such diversity contributed to the low cutting level (3 cm), baling with 75% dry matter content and rain after harvesting. These conditions led to mycotoxin production by fungi (Séguin et al., 2010). Mirocha et al. (1968) reported problems with fertility in dairy cows due to feeding contaminated hay with mycotoxins from *Fusarium* fungi. Studies reported the presence of mycotoxins in hay which affected horses (Raymond et al., 2000) and food for ruminants (Fink-Gremmels, 2008). The aim of this study was to evaluate the presence of the mycotoxins (aflatoxin, fumonisin and zearalenone) in hay dried in the sun or in shed.

Materials and Methods The experiment took place between October 2010 and January 2011, in a field of hay production located in Marechal Cândido Rondon, PR, Brazil (24 º 33'40"S, 54 º 04'12"W, 420 m elevation). The hay was from Tifton 85 grass, with 28 and 35 days regrowth and subjected to five levels of nitrogen (N) fertilization. The dehydration process was under field in the sun and in shed, in the shade. Composite samples were performed, one for each replication of N dose and age, resulting in 20 samples, half for each dehydration condition. Data was analyzed using the Mann-Whitney and means compared by Tukey test.

Results and Discussion For aflatoxins, the average of sun-dried samples (5.38 ± 1.73 µg kg^{-1}) were higher than the average of samples dried in the shade (3.07 ± 1.67 µg kg^{-1}) and although the levels of aflatoxin were low, the results were significant ($P = 0.0071$) with higher presence in the hay dried in the sun. Aflatoxin is produced by *Aspergillus flavus* and *Aspergillus parasiticus* and lingers long after formed in the food and it is heat resistant (up to 220ºC). The more known aflatoxins are B_1, B_2, G_1 and G_2, being the B1 aflatoxin the more carcinogenic substance (Domingues, 2006). Mean level of fumonisin in the samples from sun-dried hay was 90.00 µg kg^{-1} and for hay dried in the shed 60.00 µg kg^{-1} and there was not significant effect ($P= 0.8038$) in the comparison (Table 1). One possible explanation is that a mycotoxin, fumonisin, produced by *Fusarium* fungi, can produce toxins in the pre-harvesting stage, and it is regarded as the flora of grains and remains in dead plants which serve as substrate for their stay in the field and infected a subsequent crop, producing toxins (Bullermann and Tsai, 1994). The fumonisin B_1 in horses is associated with leukoencephalomalacia, and lung disease in pigs (Cast, 2003). For zearalenone, the average of sun-dried samples was 79.89 µg kg^{-1} and for the ones dried at shadow was 40.33 µg kg^{-1} and the difference was significant ($P = 0.0257$). Zearalenone (or RAL and F-2 toxin) is a potent estrogen metabolite that causes infertility, miscarriage and other reproductive problems in dairy cows, heifers and sows and it is produced by many species of *Fusarium*, especially *F. graminearum* and *F. culmorum* (Milicevic et al., 2010). One hypothesis for the highest level of mycotoxins in the dry hay in the sun may be the largest temperature range (daytime 32.4 ºC x

night 17.3 ºC) which may have stimulated the fungi to produce mycotoxins before the grass has reached moisture content below 15% (Cast, 2003). It is also speculated that the cutting height (5 cm from soil) has facilitated the contact and contamination with this remaining culture.

Conclusion It is likely that the environmental conditions and management for hay production during the harvesting and drying process are as important as the dry matter content being suitable for hay storage, in order to reduce fungi contamination and provide reduced conditions that lead the mycotoxins production. The suggestion is to conduct studies with different cutting heights from the soil with tropical grasses and consider factors such as soil moisture, conditioning at harvesting time and turning after cutting.

References

Bullerman, L.B.; Tsai, W.Y.L. 1994. Incidence and levels the fumonisins in corn and corn-based foods and feeds. Journal of Food Protection, 57:541-546.

Council for Agricultural Science and Tecnology - CAST. 2003. Mycotoxins: Risks in Plant, Animal and Human Systems. Nº 139. Ames/Iowa: CAST Task Force Report, 200p.

Domingues, J. L. 2009. Uso de volumosos conservados na alimentação de eqüinos. Revista Brasileira de Zootecnia, 38:259-269.

Fink-Gremmels, J. 2008. The role of mycotoxins in the health and performance of dairy cows. The Veterinary Journal, 176:84-92.

Milicevic, D.R.; Skrinjar, M.; Baltic, T. 2010. Real and perceived risks por mycotoxin contamination in foods and feeds: challenges for food safety control. Toxins, 2:572-592.

Mirocha, C. J., Harrison, J., Nicholis, A. A., McClintock, M. 1968. Detection of a fungal extrogen (F-2) in hay associated with infertility in dairy cattle. Applied Microbiology, 16:797-798.

Raimond, S. L., Heiskanen, M., Smith, T. K., Reiman, M., Laitinen, S., Clarke, A. F. 2000. An investigation of the concentrations of selected *Fusarium* mycotoxins and the degree of mold contamination of field-dried hay. Journal of Equine Veterinary Science, 20:616-621.

Séguin, V.; Lemauviel-Lavenant, S.; Garon, D.; Bouchart, V.; Gallard, Y.; Blanchet, B.; Diquelou, S.; Personenti, E.; Gauduchon, P.; Ourry, A. 2010. Effect os agricultural factors on the hay characteristics involved in equine respiratory disease. Agriculture, Ecosystems and Environment, 135: 206-215.

Table 1. Results of tests for the presence of aflatoxin, fumonisin and zearelenone performed by ELISA.

Variable*	Treatment	n	(μg kg^{-1})	P-value	C.V.(%)
Aflatoxin	Field drying (sun)	10	5.38	0.0071	48.23
	Drying in the shed (shadow)	10	3.07		
Fumonisin	Field drying (sun)	10	90.00	0.8030	128.87
	Drying in the shed (shadow)	10	60.00		
Zearalenone	Field drying (sun)	10	79.89	0.0257**	66.17
	Drying in the shed (shadow)	10	40.33		

*Statistics held by Mann-Whitney test. **Significant at 5% probability by Tukey test. Analyses carried out in the NUTRILAB - Nutrifarma Laboratory Analysis - Taió - Santa Catarina - Brazil.