Ruminant Nutrition Symposium: Mycotoxins—Recognizing Their Presence and Dealing with Them in Ruminant Nutrition

126 Ruminants—Are they as resilient to mycotoxicosis as we think? D. Diaz*, University of Arizona, Tucson, AZ.

Mycotoxins are mold produced feed contaminants that although undesirable are mostly unavoidable consequences of feed production. The level of mycotoxins in foods and feed can fluctuate widely and vary significantly from year to year. Although several hundred mycotoxins have been described in the scientific literature, less than 10 have been extensively studied since the discovery of aflatoxin in the early 1960s. Ruminant diets include both forages and concentrate grains, which may increase the risk of mycotoxins in comparison with grain-based monogastric diets. The multiplicity of ingredients in complex diets may increase the probability of multiple mycotoxin contamination but decrease the risk of high mycotoxin concentrations. It has been widely accepted that ruminants, due to microbial degradation, are less susceptible to mycotoxin poisoning than non-ruminants. However, rumen metabolites of the parent mycotoxin may be equally or more toxic. Because of this, differences between parent mycotoxins and their metabolites are much greater in ruminants than non-ruminants. Mycotoxins can increase disease incidence and reduce production efficiency in ruminants. They can cause dermal toxicity, reproductive effects, carcinogenicity, neurotoxicity, teratogenicity, nephrotoxicity, and hepatoxicity. Additionally, mycotoxins may affect immune function and cause lipid peroxidation. In spite of current research advances, applied aspects of mycotoxicology are either limiting or difficult to extrapolate into the real world. This review will attempt to discuss some of the most common problems related to presence of mycotoxin in ruminant diets.

Key Words: mycotoxin, ruminant, toxicology

127 Use of technology to better understand multi-mycotoxin and emerging mycotoxin challenges. A. Weaver*, Alltech Inc., Nicholasville, KY.

Mycotoxins can increase disease susceptibility as well as reduce performance, and therefore are a challenge faced by agricultural industries worldwide. Additionally, many scientific works have demonstrated that mycotoxin co-contamination can further increase risk. Despite the important role mycotoxins play in dairy cow productivity, mycotoxin occurrence and concentration are difficult to track without the support of monitoring programs. Thankfully, technology in the agricultural sector is evolving and on the rise. Various methods such as weather and soil mapping have been developed for early prediction of mold presence and may be used to assess the link between environmental conditions, soil quality, crop growth and health, mold spore transfer and mold colonization. Advances in mycotoxin analysis have also occurred. Through the advent of rapid, precise and accurate detection methods the characterization and identification of multiple mycotoxins, their metabolites, conjugated forms and emerging mycotoxins is now possible. Quantification using LC-MS/MS may provide the most accurate picture of mycotoxin risk as it allows for structural diversity, varying extraction efficiencies, interferences with complex feed matrices and potential for multi-mycotoxins. These challenges have been successfully met by developing 37+ analysis, a research backed multi-mycotoxin method applied to animal feed matrices that has been extended, optimized, and validated for 50 mycotoxins in a cost-effective manner. Over the past 6 years, the evaluation of more than 25,000 samples from around the world have demonstrated that more than 96% of samples contain mycotoxins with 89% of samples containing 2 or more mycotoxins (average 5 mycotoxins per sample). These results clearly demonstrate the need for management programs that account for multi-mycotoxin challenges. Overall, mycotoxins can be one challenge holding the dairy cow back from reaching her genetic potential. However, techniques that assess, monitor and minimize mycotoxin risk from the field to the cow are available that can manage mycotoxins and reduce effects on cow performance and profitability.

Key Words: mold, mycotoxin, technology

128 Applying fungicide on corn plants to improve the composition of corn silage for dairy cows diets. F. Cardoso*, University of Illinois, Urbana, IL.

An increasing global population, decreasing amount of arable land available for crop production in the United States, and an increased global demand for protein in the human diet encourage crop and livestock producers to seek solutions to improve the efficiency of producing large crop yields. Corn silage is one of the most commonly used forages included in dairy diets in the United States. For producers, feed costs are often the most expensive part of the operating budget. Corn yield losses may increase the cost of feed and limit herd size. The complex interaction of fungi and corn plants in the field threaten yields, decreasing the efficiency of food production and, also, the nutritive quality of feedstuffs for ruminants. By metabolizing sugar compounds within the plant cell, fungal infections on corn plants reduce the nutritional contents available for ruminant diets. Applications of fungicides can aid in protecting corn plants from fungal infection, therefore, limiting yield losses and increasing the nutritive quality of the plant material. The field of knowledge of feeding ruminants corn silage from corn treated with foliar fungicide is still narrow, but findings from previous research highlight the negatives of making and feeding silage from diseased corn plants. This presentation will summarize the knowledge available on fungi and plant relationship, limiting plant infection by applying fungicide, and how corn silage from corn with fungicide application affects dairy cow performance. It is concluded fungicide application on corn used to make corn silage for dairy cows may improve the nutritional composition of the feedstuff, as defined by increases in milk components and feed conversion, reductions in fiber concentrations, and improvements in ruminal digestibility.

Key Words: fungicide, corn silage, mycotoxin

129 Fusarium mycotoxins deoxynivalenol and fumonisins affect milk production and liver health in dairy cows. A. Gallo1, A. Minuti1, F. Piccoli Cappelli1, B. Doupovec2, J. Faas2, D. Schatzmayr2, and E. Trevisi1, 1Department of Animal Sciences, Food and Nutrition (DIANA), Faculty of Agriculture, Food and Environmental Science, Università Cattolica del Sacro Cuore, Piacenza, Italy, 2BIOMIN Research Center, Tulln, Austria.

The Fusarium mycotoxins deoxynivalenol (DON) and fumonisins (FUM) are common contaminants of dairy cow rations. Despite the rumen’s ability to degrade these mycotoxins to some extent, especially high producing cows are sensitive to these mycotoxins. The main site of DON and FUM detoxification besides the rumen is the liver. Therefore,
the aim of this study was to investigate the effect of a contamination level of DON and FUM below US and European Union guidance levels on the performance and liver enzyme activities of dairy cows. In a randomized block design, 12 Holstein cows in mid-lactation (114 ± 16 d in milk) were fed either a negative control TMR (CTR) or a TMR with a low contamination level of Fusarium mycotoxins (0.4 mg/kg DON, 1.1 mg/kg FUM) (MTX). Each of the 3 experimental periods consisted of a 3-week challenge period followed by a 2-week clearance period. Milk production was recorded daily and blood samples were collected from the jugular vein at the beginning (d 0), on d 14 and d 21 of each experimental period. Data were analyzed as repeated measurements in a completely randomized design using the MIXED procedure of SAS (SAS 9.4 TS, 2018). The mycotoxin treatment had a significant effect (P < 0.05) on the milk production. CTR animals produced on average 37.94 kg/d whereas MTX animals produced on average 36.37 kg/d (−1.57 kg/d). Liver enzyme activities in blood increased in MTX-treated cows after 3 weeks. Aspartate amino transferase (AST) activity was significantly higher (P < 0.05) in MTX treated animals (117.1 U/L) compared with CTR (106.6 U/L). While bilirubin was significantly lower in the MTX-group (1.39 µmol/L compared with 1.61 µmol/L in CTR), both alkaline phosphatase (ALP) and albumin were not affected by the MTX treatment. γ-Glutamyl transferase (GGT) activity tended to be higher (P = 0.059) in MTX-treated animals (30.7 U/L) compared with CTR animals (29.1 U/L). Considering that AST and GGT are commonly used as an indicator for hepatic lesions and function it can be concluded that dietary DON and FUM levels that comply with legal limits showed a negative effect on the milk yield and liver enzyme activities in blood of dairy cows.

Key Words: mycotoxin, liver enzyme, milk yield

130 Silicoglycidol clay for the reduction of aflatoxin M1 in urine and its effects on inflammatory biomarkers in dairy cows. E. Branstad*1, C. McCarthy1, B. Dooley1, M. O’Neil1, L. King1, C. Domenech2, J. Pié3, G. Rottinghaus4, E. Bowers1, L. Baumgard1, and H. Ramirez-Ramirez1, 1Iowa State University, Ames, IA, 2Biovet S.A., Tarragona, Spain, 3University of Missouri, Columbia, MO.

Aflatoxins produced by Aspergillus flavus and A. parasiticus can be biotransformed into AFM1, a carcinogenic metabolite excreted via urine and milk. Thus, study objectives were to determine the effects of dietary adsorbent, silicoglycidol clay (ATX), on urine AFM1 concentration, total AF fluid excretion (urine + milk), and inflammatory biomarkers in dairy cows. Twelve primiparous lactating Holstein cows (279 ± 88 kg BW) were used in a replicated 3 × 3 Latin square design with 21-d periods: (1) Control (CON) consisting of basal TMR; (2) aflatoxin (675 ± 19 kg BW) were used in a replicated 3 × 3 Latin square design with each 3 experimental period. Data were analyzed as repeated measurements in a completely randomized design using the MIXED procedure of SAS (SAS 9.4 TS, 2018). The mycotoxin treatment had a significant effect (P < 0.05) on the milk production. CTR animals produced on average 37.94 kg/d whereas MTX animals produced on average 36.37 kg/d (−1.57 kg/d). Liver enzyme activities in blood increased in MTX-treated cows after 3 weeks. Aspartate amino transferase (AST) activity was significantly higher (P < 0.05) in MTX treated animals (117.1 U/L) compared with CTR (106.6 U/L). While bilirubin was significantly lower in the MTX-group (1.39 µmol/L compared with 1.61 µmol/L in CTR), both alkaline phosphatase (ALP) and albumin were not affected by the MTX treatment. γ-Glutamyl transferase (GGT) activity tended to be higher (P = 0.059) in MTX-treated animals (30.7 U/L) compared with CTR animals (29.1 U/L). Considering that AST and GGT are commonly used as an indicator for hepatic lesions and function it can be concluded that dietary DON and FUM levels that comply with legal limits showed a negative effect on the milk yield and liver enzyme activities in blood of dairy cows.

Key Words: mycotoxin, liver enzyme, milk yield

131 Reduction of aflatoxin M1 in milk of Holstein cows administered an aluminosilicate clay. S. C. Allen*1, K. N. Russo2, D. M. Paulus Compart2, and S. H. Ward1, 1North Carolina State University, Raleigh, NC, 2PMI Nutrition Additives, Arden Hills, MN.

Thirty-five Holstein cows were utilized in a randomized complete block design to evaluate the efficacy of an aluminosilicate clay (adsorbent, FloMatrix, PMI Nutritional Additives, Arden Hills, MN) at reducing aflatoxin M1 transfer into the milk. Cows were stratified by parity, stage of lactation, and previous milk production. Cows were randomly assigned to 1 of 5 dietary treatments, and treatment was administered for 13 d (n = 7): (1) control (CON), basal TMR with no AF or clay; (2) clay control (4C), basal TMR plus 4 oz clay; (3) AF control (AFC), basal TMR plus 113 ppb AF; (4) AF diet with smaller clay dose (4C+AF), basal TMR plus 4 oz clay and 113 ppb AF; (5) AF diet with greater clay dose (8C+AF) basal TMR plus 8 oz clay and 113 ppb AF. Data were analyzed using the GLM procedure of SAS. Treatment and day were considered independent variables, and milk yield, DM and nutrient intakes, aflatoxin M1 variables, milk composition, body weight and condition, locomotion, and respiratory rate were dependent variables. A covariate adjustment was used to analyze milk yield and composition from previous milk yield records and DHIA records taken 3 d before the start of the treatment period. Means were separated using Fisher’s Least Significant Difference, and significance was declared when P ≤ 0.05. Tendencies were discussed when 0.05 < P ≤ 0.10. Data were presented as mean ± the largest standard error. Milk yield averaged 29.63, 31.85, 29.95, 29.93, and 31.30 ± 1.762 kg/d for CON, 4C, AFC, 4C+AF, and 8C+AF diets, respectively, and was greatest in cows consuming 4C and 8C+AF diets (P = 0.013). Respiratory rate and BCS were similar across treatments, and 8C+AF cows tended to have a greater locomotion score compared with other treatments (1.71 v. 1.23, P = 0.057). Aflatoxin M1 concentration, secretion, and transfer were reduced by the addition of clay (P < 0.001), and a dose response was observed. Aflatoxin M1 concentration averaged < 0.01, 0.00, 1.64, 1.26, and 0.90 ± 0.383 ppb for CON, 4C, AFC, 4C+AF, and 8C+AF cows, respectively. A reduction of transfer of 21.88 and 40.63% was observed for 4C+AF and 8C+AF diets, respectively.

Key Words: clay adsorbent, aflatoxin, milk production