Mycotoxin Survey of Straw Across the UK

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Background

Fungal pathogens are responsible for significant economic losses to cereal crops worldwide. Mycotoxins, secondary metabolites produced by fungi, pose a significant danger to the health and productivity of farm livestock, and may end up in animal products thereby posing a potential risk to human health [(1)].

Straw (produced from cereal crops) is used in farming as a constituent of animal feed and can be used as bedding for animals: where straw is used in bedding, the animals may consume the straw [(2)]. While monitoring and control of mycotoxin contamination is carried out, this is usually focused on grains and to a lesser extent on silage. Monitoring of mycotoxins in straw is generally a neglected area despite the potential risk to animals via this route. The aim of this survey was to provide data on the occurrence of mycotoxins in straw used for animal feed and bedding across the UK.

Method

Straw was sampled from farms across the UK and analysed for 12 mycotoxins simultaneously using Micron Bio-Systems' Mycocheck service. In brief, mycotoxins were extracted from the straw sample using a mixture of acetonitrile and water. Isotopically-labelled internal standards for Aflatoxins (B1, B2, G1, G2), Fumonisins (B1, B2), Deoxynivalenol, Zearalenone, Ochratoxin A, Diacetoxyscirpenol, T2 and HT2 toxin were added to each sample extract. Sample extracts were then cleaned up using solid phase extraction. Cleaned extracts were then separated using a Waters UPLC and quantified using a Waters triple quadruple mass spectrometer.

Results and Discussion

Of the 71 straw samples tested, 80.3% of straw samples contained 1 or more mycotoxins (Figure 1). 47.9% of straw samples were contaminated by only 1 mycotoxin, while 14.1% of samples were contaminated with 3 or more mycotoxins (Figure 1).

The most frequently detected mycotoxin in straw was Deoxynivalenol (DON), and was found to be present in 63.4% of samples (Figure 2). This was followed by HT2 toxin (32.4%) and T2 toxin (22.5%) (Figure 2). Aflatoxins, Fumonisin B2 and Diacetoxyscirpenol (DAS) were not detected in any of the straw samples suggesting that these mycotoxins may not currently be a problem in the UK.

48% of all wheat straw samples contained 2 or more mycotoxins, followed by barley straw samples where 40% of all samples were contaminated by 2 or more mycotoxins (Figure 3). However, 85.7% of all barley samples tested were found to be contaminated with mycotoxins compared to 66.7% of all wheat samples suggesting that barley may be a higher risk for mycotoxin contamination than wheat.

Based on current EU guidance levels for mycotoxins, the majority of straw samples fall below the maximum guidance level for all mycotoxins examined except for T2/HT2 toxins where 12.8% of the samples tested were above the recommended levels for T2/HT2 toxins (Figure 4). However, it is known that mycotoxins can act in synergy with other mycotoxins exacerbating the detrimental effects on health and performance seen in animals [(1)], and this is currently not considered within the EU guidance levels for maximum mycotoxin contamination in feed.

Results

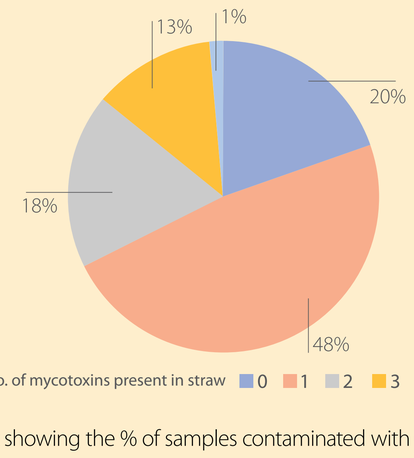

Figure 1: Pie chart showing the % of samples contaminated with 0, 1, 2, 3 or 4 mycotoxins.

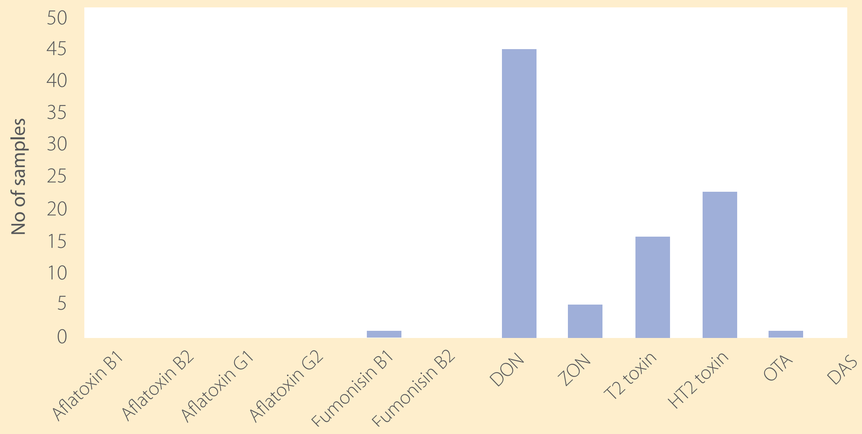

Figure 2: Graph showing the frequency of straw samples contaminated with each mycotoxin.

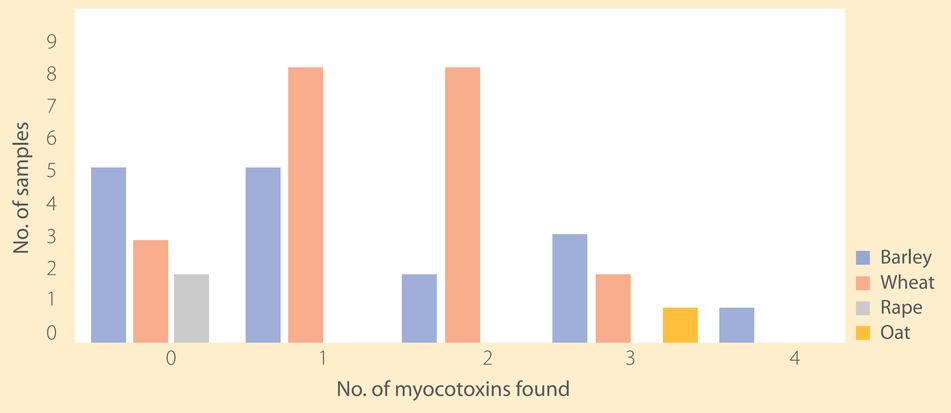

Figure 3: Graph showing the frequency of straw samples contaminated with 0, 1, 2, 3 or 4 mycotoxins for barley, wheat, rape and oat straw.

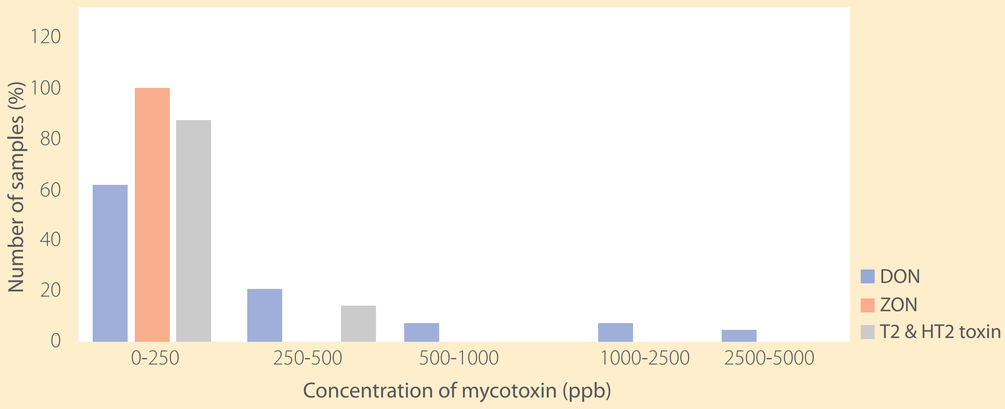

Figure 4: Graph showing the frequency of samples containing 0-250 ppb, 250-500 ppb, 500-1000 ppb, 1000-2500 ppb, and 2500-5000 ppb of DON, ZON and T2/HT2 toxins. Note that the maximum EU guidance level of DON is 5000ppb, ZON is 500ppb, and T2/HT2 toxin is 250ppb.

Conclusion

From the current survey, it is clear that straw contributes to the exposure of livestock to mycotoxins. While the majority of straw contains low levels of mycotoxins these can contribute to sub-clinical doses of mycotoxins that impact animal health, e.g. by affecting the health of the gut [(1)]. Good farm management practices should ideally include monitoring and control of mycotoxin contamination in straw to reduce the risk of exposure of livestock to mycotoxins via this route.

Finally, EU guidance levels for mycotoxin contamination of feed is currently based on individual mycotoxins, based on the results of this survey where 32.4% of samples contained 2 or more mycotoxins, it may be worth basing guidance levels on total mycotoxin content, as mycotoxins can act synergistically, increasing the risks to health, productivity and fertility. [(1)].

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References

[1] Gallo A., Giuberti G., Frisvad J.C., Bertuzzi T., Nielsen K.F. 2015. "Review on Mycotoxin Issues in Ruminants: Occurrence in Forages, Effects of Mycotoxin Ingestion on Health Status and Animal Performance and Practical Strategies to Counteract Their Negative Effects." *Toxins* 7: 3057-3111.

[2] Terre M., Pedrals E., Dalmau A., Bach A.,. 2013. "What do preweaned and weaned calves need in the diet: a high fibre or forage source?" Journal of Dairy Science 96: 5217-5225