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Monitoring the presence of ergot alkaloids in cereals

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The effectiveness of reducing ergot alkaloid content by the removal of sclerotia was also investigated. The cleaning processes studied appear to have reduced the levels of alkaloids significantly; although only a small number of samples were analysed.

Back to top

Background

Ergot alkaloids are mycotoxins produced by fungi of the Claviceps genus; the most notable in Europe being Claviceps purpurea which parasitise the seed heads of living plants at the time of flowering.

These fungal infections are most prevalent in rye, triticale that have open florets. Wheat and other small grains are also potential hosts. The fungus replaces the developing grain or seed with the alkaloid-containing wintering body that is known as ergot, ergot body or sclerotium. The sclerotia are harvested together with the cereals or grass and this process can lead to contamination of cereal-based food and feed products with ergot alkaloids. The ingestion of these alkaloids can cause ergotism in humans and animals. The main ergot alkaloids produced by the Claviceps species that are contained in the sclerotia are ergometrine, ergotamine, ergosine, ergocristine, ergocryptine, ergocornine and their corresponding '-inine' epimers.

Back to top

Research Approach

In June 2012, following a request from the European Commission, EFSA's Panel on Contaminants in the Food Chain (CONTAM Panel) delivered a scientific opinion on the risks to human and animal health related to the presence of ergot alkaloids in food and feed. The panel's recommendations included that 'collection of analytical data on occurrence of ergot alkaloids in relevant food and feed commodities should continue.' This research is in response to this recommendation. Discussions on managing the risks associated with the presence of ergot alkaloids in food and feed are taking place at the European Commission and currently negotiations are ongoing. Data generated from this work will be used to feed into those negotiations.

Current controls put in place by millers and grain processors include processes such as physical separation and cleaning through visual inspection, and separation using optical sorters to remove discoloured and mis-shapened grains. This also removes the sclerotia.

The industry has almost a zero tolerance for presence of ergot sclerotia in grains such as wheat, oat and barley – this means any visible sclerotia on inspection will lead to the entire lot being rejected. Removal of the sclerotia results in a considerable reduction in the levels of ergot alkaloids in the grain. However, it is not possible to detect the presence of dust and smaller particles resulting from breakage of the sclerotia and therefore ergot alkaloids could be present.

There are six main ergot alkaloids and corresponding epimers (12 in total) and the profile and concentration of individual alkaloids varies considerably in different grains and batches of grain. The toxicity of the individual alkaloids also varies. This study looked at the ergot alkaloid content of grains (wheat, barley, oats and rye) from the 2013 harvest, in approximately 209 samples. The effectiveness of reducing ergot alkaloid content from contaminated samples by removing sclerotia by visual and automated means was also studied in a small number of these samples.

Back to top

Results

A total of 209 samples comprised of wheat, rye, barley and oat samples destined for either human or animal consumption were analysed. Also included were samples rejected at intake for possible ergot contamination, and samples that had been ‘cleaned’ (visible removal of any apparent sclerotia) within the laboratory. These samples would not have entered the food chain.

Overall the levels of the alkaloids found in this survey were low, with the highest frequency of contamination and highest levels being determined in rye samples (64% contaminated, 369 µg/kg – the highest total ergot level), while the lowest frequency of contamination (7%) was determined in barley samples (highest total level of 31 µg/kg).

In addition, selected barley, rye and oat samples were cleaned by an industrial ergot sclerotia removal process. Samples were analysed before and after cleaning. Six samples of rye were taken prior to, and after industrial cleaning to remove sclerotia. Five of the six (83%) pre-cleaned samples contained detectable levels of ergot alkaloids compared to two (33%) of the six samples after cleaning. Total mean ergot alkaloid content dropped from 72 to 2µg/kg. Eleven rejected barley samples were analysed before and after sclerotia removal. Eight of the eleven samples had lower total ergot alkaloid content after cleaning, with three samples being reduced by 98% or greater. One oat sample was received for analysis. The initial total alkaloid content of 2501 µg/kg was reduced to 220µg/kg after cleaning.

As can be seen from the above, it appears the cleaning process has significantly reduced the levels of alkaloids, although these are not statistically relevant due to the low number of samples analysed in this work. In addition, it is reassuring that the overall levels of alkaloids found in the survey were low.

Research report

England, Northern Ireland and Wales

PDF
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