

Loss of parent fumonisin mycotoxins during food processing

Area of research interest: [Chemical hazards in food and feed](#)

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Conducted by: Premier Analytical Services

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Background

Fumonisin including FB1, FB2 and FB3 are mycotoxins produced by *Fusarium* fungi and are most commonly found in maize and therefore in maize based foods.

A joint FSA/DEFRA funded project entitled 'The fate of *Fusarium* mycotoxins during food processing', showed that in some processes the levels of parent fumonisins can be reduced and were unable to be detected using normal analytical techniques. The reduction may be because they may bind to the food or undergo a chemical change e.g. become hydrolysed. The aim of this research project was to investigate this apparent loss of parent fumonisins during food processing, to identify their fate and determine the significance in terms of the UK consumers' exposure to fumonisins.

The project investigated the levels of the following three fumonisin categories:

- Parent fumonisins – the sum of FB1, FB2 and FB3 detected in each sample using normal analytical techniques.
- Total fumonisins – the sum of parent fumonisins plus hydrolysed fumonisins (HFB1, HFB2, HFB3) and bound fumonisins, which were measured in hydrolysed forms.
- Hidden fumonisins – the difference between total fumonisins and parent fumonisins (i.e. bound and hydrolysed fumonisins)

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Research Approach

Model systems were used to investigate the loss of parent fumonisins (FB1, FB2 and FB3) by simulating the physical and chemical steps in food processes that these compounds undergo.

Simple model systems containing selected food ingredients (sugars, starch, salt, proteins) were set up to facilitate the search for hidden fumonisins. LC/MS/MS was used to detect and quantify the hidden fumonisins.

As a first stage, simple solutions of sugars, starch and protein were prepared and the potential for fumonisins to become hydrolysed or bind to these food ingredients was assessed. At the second stage, the model systems mimicked the time, temperature and pressure profiles of food

processes.

The same conditions were then used in the presence of ingredients during the manufacture of recognisable food products to identify the breakdown and/or binding of fumonisins under these conditions.

The presence of hidden fumonisins in retail food products (cornflakes, extruded maize snacks, tortilla chips) was also investigated.

An assessment was then undertaken to assess the significance of the hidden fumonisins.

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Results

Loss of fumonisins

The effect of single food ingredients such as salt, glucose, fructose and sucrose (and combinations of some of these ingredients), on the levels of parent fumonisins in naturally contaminated maize dough were studied. A decrease of parent fumonisin levels, detected by conventional analysis, was noted. Total fumonisins were found to be higher than the parent fumonisins in all cases. Additionally, applying heat increased the proportion of bound fumonisins to total fumonisins, although the total fumonisins in this case was overall lower.

The effect of food processes during the production of cornflakes, extruded snacks based on maize flour and tortilla chips was also studied. In all cases, the total fumonisins were found to be higher than the parent fumonisin determined by conventional analysis. However, all levels found were below the EC maximum legal levels.

The result of the model system work was confirmed by a small survey of commercial retail food samples.

Toxicological impact of breakdown products

During the course of this investigation, all hidden fumonisins identified in raw maize and maize-based foodstuffs were determined as hydrolysed forms.

Literature research has shown that the toxicity of the hydrolysed fumonisins is still unclear. Some researchers have reported that they showed lower acute toxicity when compared to the parent molecule, but other researchers have shown that the hydrolysed derivative may be better absorbed by the intestinal mucosa. The study of the toxicity of the bound fumonisin compounds is at an early stage and more research is required to be able to derive robust conclusions on the foods safety implications of the results.

Other potential and future research

Higher levels of total detectable fumonisins in maize and maize-based foods than levels shown by conventional analysis is worthy of further study to assess how plant metabolism, geographical location and climatic factors could also contribute to the loss of fumonisins prior to harvesting and food process. Industrial process variables may also be worthy of further investigation.

Recent literature reports indicate some *Aspergillus niger* isolates are able to produce fumonisins in high quantities on agar media with a low water activity. Several agricultural products fit this criterion, including dried vine fruits, dates and figs. However, the significance of these findings in commercial processes and consumers' exposure is not known.

Research report

England, Northern Ireland and Wales

PDF

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