Detection of apple juices and cereals which exceed permitted levels of mycotoxins

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Researchers from the University of Granada (Spain) have analysed the presence of patulin, a type of toxin produced by fungi, in several commercial apple juices. The results show that more than 50% of the samples analysed exceed the maximum limits laid down by law. They have also discovered a sample of rice with more mycotoxins than permitted. For their part, researchers from the University of Valencia have also found these harmful substances in beers, cereals and products made from them, such as gofio flour.

They are not very well known, but mycotoxins top the list of the most widespread natural contaminants in foodstuffs at the global level. They are toxic and carcinogenic substances produced by fungi, which reach the food chain through plants and their fruit. Now new analytical techniques developed in universities such as Granada and Valencia (Spain) show that some foodstuffs exceed permitted levels of these harmful compounds.

Researchers from the University of Granada (UGR) have used their own method of 'microextraction and capillary electrophoresis' to analyse concentrations of a kind of mycotoxins, patulin, in 19 batches of eight brands of commercial apple juice. They differentiated between conventional juice, organic juice and juice designed specifically for children.

"The results show that more than 50% of the samples analysed exceeded the maximum contents laid down by European law," as explained to

SINC by Monsalud del Olmo, co-author of the study, which is published this month in the magazine *Food Control*.

The maximum levels of patulin established by the EU are 50 micrograms per kilogram of product (µg/kg) for fruit juices and nectars, 25 µg/kg for compotes and other solid apple products and 10 µg/kg if those foodstuffs are aimed at breast-fed babies and young children.

However, some samples of conventional apple juices had as much as 114.4 µg/kg, and one batch labelled as baby food had 162.2 µg/kg, more than 15 times the legal limit.

Patulin is produced by several species of fungi of the Penicillium, Aspergillus and Byssochylamys varieties, which are found naturally in fruit, mainly apples. They are transferred to juices during processing because of their solubility in water and stability.

The neurotoxic, immunotoxic and mutagenic effects of this substance have been confirmed in animal models. "Even then, it is not one of the most dangerous mycotoxins for health and it is included in group 3 within the categories laid down by the International Agency for Research on Cancer (IARC)," Monsalud del Olmo pointed out.

This WHO agency classifies mycotoxins and other compounds in four groups according to their carcinogenic potential for humans: 1 (carcinogenic), 2 (probably or possibly carcinogenic), 3 (not classifiable as carcinogenic, although it has not been proven that it is not) and 4 (probably not carcinogenic).

Some mycotoxins, such as aflatoxins, are in group 1 and can be found in dry fruit, such as peanuts and pistachios, and cereals. UGR scientists have also detected concentrations of this compound above the permitted levels in a sample of rice, and they have already informed the relevant

authorities of this.

Other toxins from fungi, such as fumonisins and ochratoxins, are also included in group 2. They are found in maize, other cereals and even beer, as researchers from the University of Valencia (UV) have proven.

Mycotoxins in beer

A team from that university has used a new technique – called HLPC-LTQ-Orbitrap – to detect the presence of fumonisins and ochratoxins in samples of beer in Germany, Belgium, the Czech Republic, Italy, Ireland, Poland and Spain. The study is also published in 'Food Control'.

"They are minute quantities, although we cannot determine whether they are important because beer is one of the drinks which is not directly included in European law on mycotoxins," said Josep Rubert, UV researcher and co-author of the study.

"What this study does show is that merely controlling the raw material – barley, in this case – is not enough," added Rubert, "and that these toxins are present throughout the technological process, where it has been proven that mycotoxins that are legislated for can become hidden by joining wit glucose, so this needs to be taken into account for future research".

The same Valencian team has also analysed 1250 samples of cereal-based products from Spain, France and Germany to see whether there are differences between organic and conventional foodstuffs in the case of fumosins.

One of the most striking findings is that samples of gofio flour, commonly used in the Canaries, had concentrations of this mycotoxin in quantities greater than 1000 μg/kg, the limit established by European

law. A couple of years ago, those researchers also identified a consignment of wheat flour with concentrations of ochratoxin above the permitted level.

When the limits laid down by the EU are exceeded, scientists inform the relevant authorities, especially the European Food Safety Authority (EFSA). Then the contaminated batch must be withdrawn.

The results of the study of cereal-based foodstuffs show that almost 11% of the organic products examined contain fumosins, whereas in conventional products this percentage is reduced to around 3.5%. This data has been published in the magazine *Food and Chemical Toxicology*.

"The explanation could be that organic foodstuffs do not contain fungicides or other pesticides, so fungi may have a more favourable environment and increase their toxins. However, in any case, there are other important factors such as climatic conditions – heat and humidity benefit these microorganisms – and storage conditions which also influence the production of mycotoxins," said Rubert, who recognises that analysis must be done on a case-by-case basis.

In fact, in the study of apple juices, the opposite happened, and the organic products had fewer mycotoxins than the conventional ones. What the researchers do agree on is the need to keep defining the toxicity of each of these harmful substances, studying their effects on health and developing more and more exact methods of analysis.

More information: Victor-Ortega, M. et al. Evaluation of dispersive liquid-liquid microextraction for the determination of patulin in apple juices using micellar electrokinetic capillary chromatography, *Food Control* 31: 353-358, 2013.

Rubert, J. et al. Mass spectrometry strategies for mycotoxins analysis in

European beers, *Food Control* 30 (1): 122–128, 2013.

Rubert, J. et al. Occurrence of fumonisins in organic and conventional cereal-based products commercialized in France, Germany and Spain, *Food and Chemical Toxicology*, 2013.

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