

Food Safety – A New Standard in Nitrofurans Analysis

Partnership EU-China

The development of new methodologies for nitrofurans analysis has been a collaborative effort between Teagasc Food Research Centre in Dublin, Ireland and the China Agricultural University (CAU) in Beijing, China. Teagasc's main objective was to develop a confirmatory method, whilst CAU set out to develop screening methods for nitrofurans. This collaboration has involved the exchanging of methods and materials between the laboratories and a number of visits between the two sites.

Definition of problem

Nitrofurans are a class of synthetic, broad-spectrum antibiotics which are completely banned from use in food-producing animals, given their undesirable toxicological properties which pose a threat to human health. Due to the efficacy, availability, and low cost of nitrofurans drugs, their illegal use still occurs and hence, to ensure food safety, strict legislation exists for monitoring the levels of their marker residues in food. Nitrofurans are administered in their parent form, but are rapidly metabolised to form highly stable, protein-bound metabolites, which persist for long periods of time. These bound metabolites serve as marker residues for the detection of nitrofurans in food. Methodology for analysing the bound residues is standard in most countries, but the sample preparation is very time consuming and the analysis primarily focuses on only four main compounds. The aim of this work was to overcome these limitations by developing a rapid, high throughput LC-MS/MS method, with an extended scope of analysis.

Pathway to solution

LC-MS/MS stands for liquid chromatography coupled to tandem mass spectrometry and it is one of the most powerful analytical tools for monitoring veterinary drug residues. In this research, a new LC-MS/MS method was developed for the separation and detection of eight nitrofurans residues, comprising of the four original compounds and four further drugs. Additionally, an alternative protocol for sample preparation was developed to shorten the laboratory turnaround times. The standard approach to nitrofurans analysis involves an 16 h overnight incubation step, followed by a lengthy double liquid-liquid extraction. A rapid alternative was developed using a 2 h microwave-assisted reaction, followed by a QuEChERS-based extraction, which stands for Quick Easy Cheap Effective Rugged and Safe. These changes to the sample preparation reduced the analysis time by half, from four days to just two days. The new rapid method underwent full validation in accordance with EU legislation and is now an accredited method for nitrofurans analysis on the National Residue Control Plan in Ireland. Furthermore, the method's Standard Operating Procedure (SOP) has been sent to laboratories across the globe, including countries such as China, Poland, Austria, the Netherlands, and the UK.

Another main objective of the nitrofurans research was to confirm the metabolites of two new nitrofurans drugs and to assess their suitability for use as marker residues during analysis. The metabolites of nitrovin and nifuraldezone had previously been predicted through the assessment of their chemical structures, but they had not been verified. In this work, incurred materials were produced and the animal tissues were analysed using the newly developed method. From these studies, aminoguanidine and oxamic acid hydrazide were confirmed to be the drug metabolites and were found to be suitable marker residues for monitoring abuse of nitrovin and nifuraldezone in food-producing animals.

Long term impact

Overall, major advances have been made in nitrofurans analysis, which will ensure greater food safety against these zero tolerance substances. The development of rapid methodology and the confirmation of new marker residues will lead to improvements in the harmonisation of trade between the EU and China. The technology can now be used by EU and Chinese laboratories to ensure the safety of products traded between the two regions and ensure supply lines for importers and retailers.