

PHARMACEUTICALS IN THE TERRESTRIAL ENVIRONMENT: RESISTANCE TO BACTERIAL DEGRADATION AND ENVIRONMENTAL IMPLICATIONS

Clare REDSHAW, Steve ROWLAND and Anthony LEWIS

1. School of Earth, Ocean & Environmental Sciences, University of Plymouth, UK.

Since the EU banned sea disposal of sewage sludge (SS) in 1998 the application rate of SS to land has risen significantly (e.g. 52% in the UK in 2000) and is set to rise further, Land application is thus possibly an important transport route for SS-associated organic chemicals into the environment. The last decade has also seen an increase in reports of pharmacologically active compounds in the environment (e.g. in watercourses, open ocean, soil). We have therefore investigated the biotic fate of two pharmaceuticals, Prozac (fluoxetine HCl) and Valium (diazepam) and their major human metabolites (Figure 1) in SS-amended soil.

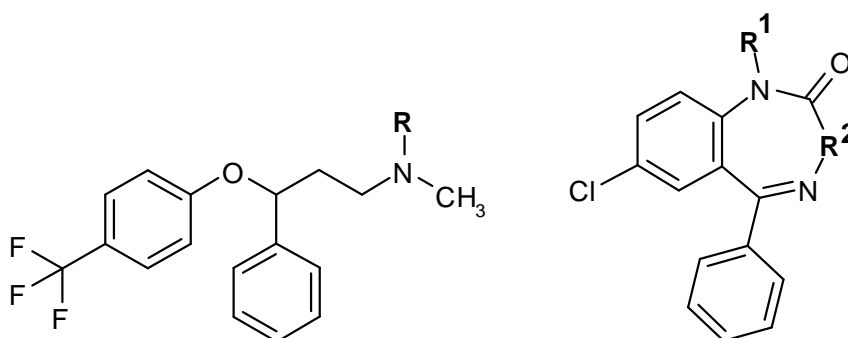


Figure 1. Structures of target compounds

Fluoxetine ($R = H$), Norfluoxetine ($R = CH_3$), Diazepam ($R^1 = CH_3$, $R^2 = CH_2$), Temazepam ($R^1 = CH_3$, $R^2 = OH$) and Oxazepam ($R^1 = H$, $R^2 = OH$).

A simple extraction technique, including solid phase extraction was developed, which allowed subsequent analysis by high performance liquid chromatography – electrospray ionization – multistage mass spectrometry (HPLC-ESI-MSⁿ). Ratio calibration using deuterated internal standards allowed the generation of quantitative data. All target compounds were found to be resistant to biodegradation under environmentally relevant conditions, even after prolonged exposure (>200 days) to SS-acclimatized bacterial consortia. This may have implications for the subsequent accumulation in SS-amended soils and possible subsequent uptake into plants grown on the soils. Preliminary results for pharmaceutical uptake into *Brassicaea* crops will be reported.