Abstract

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<th>Pharmaceutical Compounds and Microplastics in Sewage Sludge for Agricultural Use: Analytical methods and Biological degradation</th>
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1. Introduction

Sewage sludge is an unavoidable by-product of wastewater treatment plant and may carry many contaminants such as pharmaceutical compounds and microplastics. The fate of pharmaceuticals and microplastics in paddy soil must be known for the effective utilization of sewage sludge as fertilizer. In this study, assuming the application of sewage sludge to paddy soils, the degradation of pharmaceuticals and recovery of microplastics by soils of different origins was investigated.

2. Material and Methods

The metabolite of the cholesterol-lowering clofibrate drug clofibric acid [CA] and others Six non-steroidal anti-inflammatory drugs (ibuprofen [IBP], fenoprofen [FEP], ketoprofen [KEP], naproxen [NPX], diclofenac [DCF] and indomethacin [IDM]) were added at 200ug/L into different paddy soils (Kawagoe [Jun 2017/Dec 2017], Iris garden [Oct 2017], Niigata [June 2018] and Ome [September 2018]). The effect of pH and DO on the degradation were investigated. All samples were incubated at room temperature for 14 days. After the incubation, samples were subjected to centrifugation to separate supernatant phase from sludge phase, followed by solid phase extraction (C18) and derivatization before the measurement by gas chromatography-mass spectrometry (GC/MS).

Although concerns on soil MPs has been increasing, there is still a lack of standard method for MPs analysis in soil and sludge. 50 pieces of polyester fiber normally used as handicraft were purchased and cut with scissors into shorter lengths. 5g of soil samples were put into centrifuge tubes with the polyester fibers. Different solutions including distilled water, NaCl and NaI were added to extract the microplastics by flotation. The centrifugation is carried out after flotation and the supernatant was collected and filtered. The filters were then inspected with a microscope to quantify the number of the fibers. The recovery rate of microplastics was calculated.

3. Results and discussion

The results clearly indicated that, aerobic condition facilitated the target pharmaceuticals except for NPX. Also no anaerobic degradation of CA, IBP, FEP and KEP was observed. Higher degradation (residual ratios were less than 60%) was found for DCF regardless the origin of soils, while only slight degradation of CA was observed. The degradation spectrum in soil was different from that in typical biological wastewater treatment, in which DCF is generally persistent. Degradation spectrum for pharmaceuticals was dependent on the origin of soil. Higher adsorption to soil was observed in the acidic pH condition in soils.

Three sequential extractions were enough to obtain a considerable recovery rates. The highest recovery rate of polyester fibers in sample from Ome soil was 60%, while in the case of Niigata the highest recovery rate was 76%. In all cases, the third extraction by NaI was effective for the recovery of the fibers. Future study is needed to clarify the biological degradation of MPs in soils by using the developed method in this study.

注１：英語要旨—500 ワード程度