



Composting of swine manure spiked with sulfadiazine, chlortetracycline and ciprofloxacin

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ABSTRACT

The fate of chlortetracycline (CTC), sulfadiazine (SDZ) and ciprofloxacin (CIP) during composting of swine manure and their effect on composting process were investigated. Swine manure was spiked with antibiotics, mixed with saw dust (1:1 on DW basis) and composted for 56 d. Antibiotics were spiked to a final concentration of 50 mg/kg CTC + 10 mg/kg SDZ + 10 mg/kg CIP (High-level) or 5 mg/kg CTC + 1 mg/kg SDZ + 1 mg/kg CIP (Low-level), and a control without antibiotics. Antibiotics at high concentrations delayed the initial decomposition that also affected the nitrogen mineralization. CTC and SDZ were completely removed from the composting mass within 21 and 3 d, respectively; whereas, 17–31% of the spiked CIP remained in the composting mass. Therefore, composting could effectively remove the CTC and SDZ spiked even at high concentrations, but the removal of ciprofloxacin (belonging to fluoroquinolone) needs to be improved, indicating this antibiotic may get into the ecosystem through land application of livestock compost.

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1. Introduction

Replenishment with organic matter such as livestock excretions is a major approach to restore the degraded soils due to excessive application of inorganic fertilizer. Use of livestock excretions has been promoted by the Ministry of Agriculture of China since 1992 through the “Rich Soil Project”. Besides, it is a common practice for organic farmers to utilize livestock wastes after composting for restoring soil fertility. However, the heavy use of antibiotics for disease prevention and curing in livestock animals has raised the concern it may serve as an important pathway for the spreading of antibiotics into soil because unlike human manure, waste from farms does not undergo tertiary wastewater treatment (Kim et al., 2011). Therefore, removal of antibiotics from livestock waste before their application to soil is becoming an emerging environmental issue.

Livestock waste represents a huge issue in many countries due to their discharge into the water bodies without any treatments causing eutrophication. With the implementation of livestock ordinance, all livestock waste needs to be collected and disposed of by landfilling or composting. Composting provides an economical and environment-friendly approach for stabilizing livestock waste and convert it into a good organic fertilizer or soil conditioner, which will be easier to handle than raw wastes. Besides, the application of raw waste will easily lead to leaching of nutrients into the soil aquifer

and contaminate ground water. During composting process, the presence of a wide variety of complex organic compounds will encourage the development of a wide diversity of microorganisms of large population (Díaz et al., 1993). This creates an appropriate composting condition for the removal of antibiotics presence in the livestock waste. Recent studies reported the effectiveness of composting on the removal of several kinds of antibiotics, i.e. Penicillins, tetracyclines (chlortetracycline [CTC] and oxytetracycline [OTC]) and polyether antibiotics (salinomycin) (Arikan et al., 2007, 2009a,b; Kakimoto et al., 2007; Ramaswamy et al., 2010; Zhang et al., 2006). The removal efficiencies of different kinds of antibiotics in livestock and poultry manure varied significantly ranging from 40.2% for oxytetracycline to more than 99% for penicillin, salinomycin and CTC, as well as 100% removal for amoxicillin; while the possible reason for such varying removal efficiencies is largely unknown since there is an extreme lack of information on the mechanisms responsible for the antibiotics removal during composting.

Tetracyclines, sulfonamides and fluoroquinolones are frequently used in livestock farming and consequently, livestock excretions were found to contain considerable levels of these antibiotics. A maximum concentration of 200 mg/L of tetracyclines in the swine slurry (Kumar et al., 2005) was reported. Sulfonamides in manures have been found at concentrations from 8.7 to 12.4 mg/kg (Haller et al., 2002). Occasionally, very high concentrations have been reported such as almost 500 mg/kg slurry for sulfadiazine (SDZ) (Grote et al., 2004). In case of CIP, up to 33.98 and 29.59 mg/kg in manure samples from swine and cow, respectively were reported (Winckler et al., 2003). Therefore, the aim of this

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