FATE of ANTIMICROBIALS in MANURE DURING ROTARY DRUM COMPOSTING

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Livestock is one of the fastest-growing agricultural sectors to meet the food demand of rising human population. Massive amounts of animal waste are generated from the industrial farms. Proper management of this waste has prime importance for not only minimization of the waste but also elimination of manure pollutants including various gaseous, nutrients, pathogens, and antimicrobials since manure is traditionally used as a fertilizer. Rotary drum composting performed in closed systems with controlled aeration can be a promising method for the reduction of those pollutants and volume of manure.

In this study, two identical rotary drum reactors were operated up to 20 days to investigate the effect of rapid composting on fate of manure's own antimicrobials and the results were compared with those obtained with static composting bin. After the characterization of manure samples, proper compositions for rapid composting were prepared by blending of dairy (D), broiler (B), and layer-hen (L) manures. The performances of composting process for DB and DL manure mixtures as well as individual B and D manures were evaluated at different operational conditions.

The results of composting trials clearly showed the positive influence of both high water extractable carbon content and high specific oxygen uptake rate of raw manure on microbial activity during the process. Although the blending of D and B or L manures resulted in higher antimicrobial pollution load in the mixture, the time to attain the peak composting temperature (68-73°C) was reduced and higher peak temperatures were achieved in mixed manures compared to the composting of D manure alone probably by enrichment of microbial community. However, degradation rates of antibiotics highly depended on their initial concentrations. While the composting with high aeration rate ($17\pm3 m^3.h^{-1}$) caused a decrease in composting temperature, the elevated temperature achieved with low aeration rate (3.6 ± 0.2 $m^3.h^{-1}$) did not improve antimicrobial reduction indicating the importance of biotic processes. Practicing high aeration rate during the composting reduced the half-life of antibiotics remarkably regardless of manure blending. For instance, it was reduced from 27 to 6.3 d for enrofloxacin in DB manure and from 37 to 3.8 d for oxytetracycline in D manure. In both type of manure, the composting caused the transformation of enrofloxacin to its main metabolite ciprofloxacin that is relatively persistent than other antibiotics detected in manure samples. Compare to static composting the rotation of the drum provided more efficient antimicrobial reduction obviously by providing uniform mixture of nutrients, and air.

Keywords: Antimicrobial, compost, fate, manure, rotary.