

CFOs

Confined Feeding Operations

Unabsorbed Antibiotics and the Potential Contribution to Antibiotic Resistance

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Antibiotics are used in animal agriculture to prevent or treat bacterial infections. As with many medicines, antibiotics are not completely absorbed by the animals. Inevitably, unabsorbed antibiotics, some in their active forms, are excreted in animal waste. In the US, livestock manure is generally applied to land as a fertilizer. While animals may excrete unabsorbed antibiotics, much of the active form of the antibiotics is destroyed during decomposition as the manure is stored prior to application. (See [link](#) for further reading. Once applied to land, antibiotics further break down in the soil or through exposure to direct sunlight. Thus, with each step, the concentration of antibiotics is significantly reduced. However, in some cases, antibiotic compounds or residues have been detected in surface waters surrounding livestock operations, similar to what occurs with treatment of human waste water. The impact of antibiotics in low concentrations in these specific locations remains unclear.

Much of the concern, however, revolves around the possibility that unabsorbed antibiotics could lead to increases in antibiotic resistance once the manure is applied to soil or through runoff from field where manure was applied. Increases in antibiotic resistant bacteria result from direct exposure of a bacteria community to an antibiotic. In this process, the growth of antibiotic susceptible bacteria is inhibited due to the lethal effect of the antibiotic, while the growth of antibiotic resistant bacteria, even at low population, is not affected. With much less competition, antibiotic resistant bacteria can then become a higher percentage of the total bacterial population. While most of these antibiotic resistant bacteria may indeed be harmless, some bacteria have the capacity to transfer genetic traits (such as antibiotic resistance) horizontally to other unrelated types of bacteria.

As with most drugs, an antibiotic needs to reach a certain concentration to elicit a lethal effect on a susceptible bacterium. The concentrations of antibiotics in soil or water containing manure are usually several hundred or thousand times lower than such required concentrations. As such, these concentrations were considered unable to inhibit the growth of susceptible bacteria or select for antibiotic resistance (Drlica 2003; Drlica and Zhao 2007). However, the results of several recent studies indicated that antibiotics at extreme low concentrations should also be of concern. One such study (Gullberg 2011) showed that, under laboratory conditions, tetracycline and ciprofloxacin at very low concentrations could increase the percentages of resistant bacteria when both antibiotic susceptible bacteria and resistant bacteria were present together. This was done under laboratory conditions. Thus, the question becomes whether antibiotic selective effects can also be observed at such low concentrations under environmental conditions. Currently, research addressing this question is largely lacking. One study exists which used conditions resembling the field and traced the fate of the antibiotic sulfadiazine throughout its journey from oral administration in piglets to manure storage to soil application (Heuer 2008). In this study, the selection of antibiotic resistant bacteria was not observed with the presence of sulfadiazine, or its metabolites, at the final concentrations detected in the soil. Unlike laboratory conditions, soil contains very diverse bacterial populations. Coupled with antibiotic adsorption to the soil matrix, and biotic/abiotic degradation of antibiotics, emergence of antibiotic resistant bacteria in soil is likely much more difficult than in the laboratory (Chait 2012). However, before we can better assess the risk of environmental antibiotic residues, farms employing practices that reduce the need for antibiotics should be encouraged to continue doing so.

As with almost all issues we highlight on this series, it is worth noting that land application of manure containing unabsorbed antibiotics is not an issue specific to CFOs. The use of antibiotics is a common practice in conventional livestock and poultry production—both large and small—to prevent or treat animal diseases. CFOs, while holding more animals by definition, however, could be predicted to generate larger volumes of antibiotic-containing manure.

References

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