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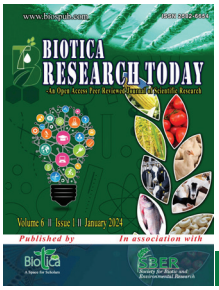

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Antibiotics in Manure: Threat to Soil and Human Health

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Abstract

The last century has seen a global growth in the usage of antibiotics, and this trend is expected to continue. The increased level of antibiotic resistance in soils is a result of the misuse of veterinary antibiotics in animal husbandry and the ensuing manure applications to the land. Over half of the veterinary antibiotics that are taken are excreted in the environment, accounting for approximately 58% of the total. As a result, animal manures and soil treated with manures can contain antibiotic concentrations up to mg L^{-1}, as well as a broad range and frequency of antibiotic resistance genes (ARGs). As a result, worries about these compounds' ability to find their way into human food and endanger human health have been expressed.

Keywords: Antibiotics, Antibiotic resistance gene, Health, Manure

Introduction

The late 1940s marked the discovery of antibiotics' ability to promote growth in agricultural animals, specifically in pigs and chickens. Antibiotics have greatly improved feed efficiency and livestock productivity, but due to their impact on the emergence of resistance in some harmful bacteria in the animal's stomach and on the terrestrial setting. Concern over the usage of antibiotics to encourage animal development is rising these days. Low concentrations of antibiotics are also introduced into the soil and water by the ongoing use of antibiotics in feed, which is facilitated by animal waste. This leads to soil microbes, especially pathogenic bacteria, developing antibiotic resistance. Many causes have been linked to the rise of antibiotic resistance, such as the abuse of prescription drugs in human and livestock medicine and their use as inducers of growth in animal feed.

Global Patterns of Antimicrobial Utilization in Animal Feed

According to projections made by the *Organization for Economic Cooperation and Development (OECD)*, the global usage of antibiotics in food animals is expected to rise by 67% from 63,151 tons in 2010 to 105,596 tons by 2030. According to the study, some of the most often used antibiotics worldwide include quinolones, tetracyclines, and penicillins; usage of these drugs is higher in nations where the diet is high in meat.

Antibiotic Use in Livestock in India: By 2030, India's animal feed industry would use 82% more antibiotics. By 2030, India is anticipated to triple its usage of them, namely in hens (Koch *et al.*, 2021).

Veterinary Antibiotics' Intrusion into Agriculture

The kinds and quantities of antibiotics in agricultural soils when given as animal manure depend on the animal species involved, how long the medication is given for, and how quickly the antibiotics are excreted. It's anticipated that 75% of antimicrobial agents administered to animals might end up in nature. Half the antibiotics that are extracted (such as tetracycline), roughly 25% of the oral dosage, are eliminated through faeces, and the remaining 50-60% are eliminated unaltered through urine. Since the percentage of antibiotics in animal waste can approach mg L^{-1} levels, direct application of the manure can be the primary source of antibiotic invasion into a soils and the surrounding ecosystem.

The Emergence of Antibiotic Resistance

Although antibiotic resistance develops naturally, improper use of antibiotics by people and animals is hastening the process. As bacteria or different organisms develop a resistance to the drugs intended to eradicate them,

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antibiotic resistance arises. This suggests that the germs are not eliminated and can continue to grow. Treatment for infections that are resistant to treatment might be difficult or perhaps impossible. Figure 1 explains the horizontal gene transfer of antibiotic resistance.

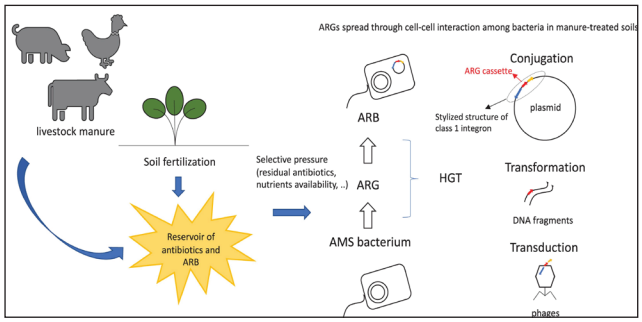

Figure 1: Spread of ARGs and ARB in farm-related environments. ARB, antimicrobial resistant bacteria; ARG, antibiotic resistance gene; AMS, antimicrobial sensitive; HGT, horizontal gene transfer (Checcucci *et al*., 2020)

The mechanisms included in the resistance approaches are as follows:

1. The deactivation of antibiotics by enzymatic breakdown or alteration.

2. Cellular modification by means of chemical receptor over-expression or protection.

3. The production of impervious barriers that prevent antibiotics from entering bacterial cells and an upsurge in export mechanisms that transport antibiotics off the cell.

Eco-Toxicological Repercussions

The following are some possible effects of the antibiotics on the soil:

1. Modify the variety and make-up of native soil microbial populations, which are vital to ecosystems;

2. Modify the role of nitrifying bacteria in the natural metabolism of nutrients;

3. Prevent the breakdown of organic compounds;

4. Modify the energy's pathway; and

5. Increase tolerance in soil-dwelling organisms-even cross- and multiple resistances.

Impact on Human Health Due to ARGs Abundant Food Intake

Using vegetables cultivated on the manure-amended soil may have health hazards due to these antibiotics. Antibiotics and other pharmaceuticals can have harmful consequences for human health, such as causing inflammatory responses in the liver when diclofenac is used or slowing down the formation of embryonic cells (Zhang *et al.*, 2014). Studies have indicated a connection between the environmental presence of antibiotics and the long-term toxicity of some species as well as the promotion of ARB.

Escherichia coli (*E. coli*) bacteria that are resistant to antibiotics have been clearly demonstrated in the excrement of broilers, chickens, and turkeys. These germs are capable of spreading from animals to people. Excessive usage of antibiotics can result in the emergence of germs that are resistant to treatment, causing illnesses in both humans and animals.

Table 1: Drug resistivity associated with infection causing microbes in human (Samtiya *et al*., 2022)

Resistance	Description
Carbapenem-Resistant *Acinetobacter* (CRA):	• CRA causes pneumonia, urinary tract infections and wound infections. *Acinetobacter* is linked to the spoilage of meats and vegetables. • *Acinetobacter baumannii* is of considerable concern since it cannot be treated with existing antibiotics.
Drug-Resistant *Campylobacter*:	• *Campylobacter* is a major cause of foodborne illness and is associated with raw poultry and unpasteurized milk. • Around 29% of all infections are associated with strains that have reduced sensitivity to fluoroquinolones or macrolides (azithromycin), antibiotics used to treat severe *Campylobacter* infections.
Vancomycin-Resistant *Enterococcus* (VRE):	• Bloodstream infections are most often caused by Vancomycin-resistant *Enterococcus faecium*. • Over 70% of *E. faecium* are vancomycin-resistant, the antibiotic of choice for treating *E. faecium* infections.

Conclusion

Indiscriminate and unregulated use of antibiotics has increased their occurrence and persistence in manures, in soils and human made environments. Given that these antibiotics create ARB with ARGs both inside our bodies and in the natural world, they pose a health risk. Effective steps are thus required to contain this growing issue, including enhancing antibiotic efficacy, halting the transmission of resistance genes and keeping a careful eye on the presence of antibiotics in animal feed and manure.

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