Chapter 5

Use of Antibiotics in Animals and Its Possible Impacts in the Environment

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ABSTRACT

The application of antibiotics to livestock has become a serious global concern. The increasing demand for animal protein leads to a greater use of antibiotics in livestock production. This is contributing to a global scale-up in antibiotic consumption. This chapter analyses the use of antibiotics in animals and the emergence of antibiotics as a class of contaminants which pollute the natural environment and create antimicrobial resistance. The conclusion is that the current system is unable to withstand ethical health concerns.

INTRODUCTION

Humans have been using various pharmaceuticals for different therapeutic purposes since the mid-1800s. These diverse classes of pharmaceuticals include antibiotics, antipyretics, analgesics, antiepileptic drugs, antihistamines, antidepressants, β-blockers, non-steroidal anti-inflammatory drugs (NSAIDs), steroids, hormones and many others. However, from an environmental perspective, pharmaceuticals are indistinguishable from any other chemicals. At the end of 20th century with the development in analytical science, they emerged as micro-contaminants. At present, they are listed under the categories of emerging contaminants by the United States Environmental Protection Agency (USEPA). Emerging contaminants can be broadly defined as any synthetic or naturally occurring chemical or any microorganism that is:

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not commonly monitored but has the potential to enter the environment and cause known or suspected adverse ecological and/or human health effects (USGS, 2017). This includes personal care products, perfluorinated compounds, flame retardants, endocrine disrupting chemicals, plasticizers, industrial additives and agents, surfactants and pharmaceuticals. To date, many articles have reported the widespread occurrence of pharmaceuticals and their residues in surface waters, ground waters, wastewaters, sediments, sludge, animal manure and biota. Their concentration varies from picograms to micrograms levels.

Antibiotics are one of the important classes among the emerging contaminants. For instance, occurrence of antibiotics was determined in the effluents from hospitals, residential facilities and dairies, municipal wastewater, influent and effluent of a wastewater treatment plant (WWTP) and surface waters in New Mexico (Brown et al., 2006). Presence of antibiotics was detected in three hospital effluents, five WWTPs, six rivers and a drinking water storage catchment within watersheds in South–East Queensland, Australia (Watkinsona et al., 2009). Significant levels (μg/l) of pharmaceuticals that include antibiotics, estrogens, non-steroidal anti-inflammatory drugs (NSAIDs), beta-blockers and lipid regulators were frequently detected in the urban regions of Taiwan’s surface waters (Lin & Tsai, 2009). The occurrences of pharmaceuticals belonging to predominant therapeutic classes was detected in surface water, suspended solids and sediments in the Ebro river basin in Spain (da Silva et al., 2011). Presence of sulfonamides was found in two ground waterbodies in Catalonia indicated manure contamination from livestock veterinary practices (García-Galán et al., 2010). Despite this, limited information exists on the impacts of antibiotics on the environment.

GLOBAL ANTIMICROBIAL CONSUMPTION IN LIVESTOCK

The increased demand for animal protein that leads to greater use of antibiotics in livestock production is considered one of the trends contributing to a global scale-up in antibiotic consumption. This trend began just after the Second World War when there was a lack of good quality feed (Aarestrup, 2012). Antibiotic consumption in livestock worldwide is twice that of humans (Aarestrup, 2012; WHO, 2012). For instance, in the United States ~80% of the nation’s annual antibiotic consumption accounted for antimicrobial use in animals (CDDEP, 2015; Van Boeckel et al., 2015).

In a study conducted to analyze antimicrobial consumption in livestock production, Van Boeckel et al. (2015) estimated that the global average annual consumption of antimicrobials per kilogram of animal produced was 45 mg/kg, 148 mg/kg and 172 mg/kg for cattle, chicken and pigs respectively. On the basis of this baseline data, the study estimated that between 2010 and 2030, the global consumption of antimicrobials in food animal production will increase by 67%, i.e. from 63,151 ± 1,560 tonnes to 105,596 ± 3,605 tonnes. Two thirds (66%) of this global increase is attributed to the increase in the number of animals raised for food production. The remaining third (34%) results from the shift toward intensive production systems in middle-income countries where antimicrobials are used routinely in sub-therapeutic doses for disease prevention and growth promotion, rather than for disease treatment. The study also reported that the five countries with the largest shares of global antimicrobial consumption in food animal production in 2010 were China (23%), the United States (13%), Brazil (9%), India (3%), and Germany (3%). If current trends continue, by 2030 this ranking is projected to be China (30%), the United States (10%), Brazil (8%), India (4%), and Mexico (2%). This means, by 2030 antimicrobial use in livestock production in Brazil, Russia, India, China and South Africa (BRICS) will increase by 99% which is seven times the projected population growth in this group of countries.