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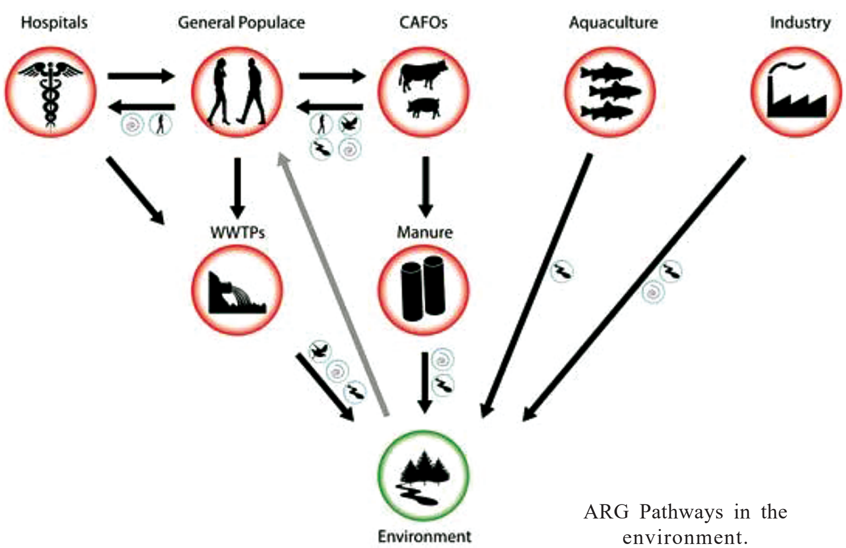
MINNOVATION™

What is the connection between lignite and antibiotics? An application innovation?

Lignite, often referred to as brown coal, is a soft brown combustible sedimentary rock that is formed from naturally compressed peat. It is considered the lowest rank of coal due to its relatively low heat content. It is mined in China, Bulgaria, Greece, Germany, Kosovo, Poland, Serbia, Russia, Turkey, the United States, Canada, India, Australia, and many other parts of Europe, and it is used almost exclusively as a fuel for steam-electric power generation. But it is also mined for its germanium content in China. The percentage of Germany's electricity that comes from lignite power plants is 26.3%, while in Greece, lignite provides about 50% of its power needs. Lignite is brownish-black in colour and has a carbon content of around 25–35%, a high inherent moisture content, sometimes as high as 66%, and an ash content ranging from 6% to 19%. Lignite is also used as a natural adsorbent. The porous structure of lignite could provide adequate free oxygen and suitable habitat for the growth of microorganisms in the soil. Addition of lignite is reported to accelerate organic matter degradation and ammonium formation during composting. Moreover, experiments demonstrated that lignite may alter the composition and abundances of microbial communities and reduce ammonia-oxidizing bacteria population size by slowing down the rate of urea hydrolysis to ammonium in soils.

The global consumption of antibiotics has substantially increased in recent decades. Antibiotics are used widely for reducing disease incidence or promoting growth, which account for 70~80% of the total global antibiotic consumption. Most antibiotics are poorly metabolized in the guts of humans and animals, and approximately 30~90% of them are released via excreta and animal manures and urines to soils and groundwaters, where antibiotic residues can lead to the evolution and development of antibiotic resistance genes (ARGs). From the sewage, landfills, to the application of animal manures in agriculture management practice, all these result increase in the diversity and abundance of soil ARGs as well as their movement to the food chain. Every step enhances the dissemination of ARGs to soil microbial communities through the pathway of horizontal gene transfer (HGT) modulated by mobile genetic elements (MGEs). A recent study demonstrated that lignite addition (5%, 10% and 15%, wt/wt) significantly promote the removal of ARGs during 65 days of poultry litter composting – a cohort, signifying that it will work in similar way in other application – with the highest removal rates observed in the 15% lignite treatment. The shift of bacterial communities, especially the Actinobacteria and Firmicutes, induced by the alteration of physiochemical parameters (ash, NH4+-N and pH) may be a major driver for the reduction of ARG abundances. Altogether, this study provides evidence that lignite as additives can be a promising strategy to reduce the burden of ARGs. (Acknowledgement and for more details: Lignite as additives accelerates the removal of antibiotic resistance genes during poultry litter composting, Yun Cao et.al., Bioresource Technology, July 2020).



ARG Pathways in the environment.