Antibiotics are one of the most important medical discoveries of the 20th Century and remain an essential tool for treating animal and human diseases.

However, antibiotic resistance among bacterial pathogens and concerns over their extensive use in animals has garnered global interest in limiting their use in animal agriculture.

There is therefore a critical need to explore the scientific breakthroughs and novel technologies that provide alternatives to antibiotics.

The international symposium Alternatives to Antibiotics in Animal Production (www.ars.usda.gov/alternativestoantibiotics) was organised to assess promising research results and novel technologies that could potentially provide alternatives to antibiotics in animal agriculture. Some of these new technologies have direct applications as medical interventions for human health, but the focus of the symposium was animal production, animal health and food safety.

Five subject areas were explored in detail through scientific presentations and expert panel discussions:
1. alternatives to antibiotics, lessons from nature,
2. immune modulation approaches to enhance disease resistance and treat animal diseases,
3. the gut microbiome and immune development, health and diseases,
4. alternatives to antibiotics for animal production,
5. regulatory pathways to enable the licensure of alternatives to antibiotics.

This article reviews promising technologies selected from the 110 scientific presentations included in the symposium.

Importantly, challenges and recommendations for advancing the development and commercialization of alternatives to antibiotics are provided.