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ANTIBIOTIC USE IN POULTRY: EFFECTS ON HEALTH, PRODUCTION AND ANTIMICROBIAL RESISTANCE

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ABSTRACT

Antibiotics are valuable therapeutic tools in poultry production that can be used to control bacterial infections and maintain poultry health and productivity. However, when antimicrobials are used inappropriately, microbial balance in the intestine can be upset, antimicrobial resistance (AMR) can be promoted, and concerns can be raised about antibiotic residues, food safety and public health. This article addresses the impact of antibiotic use on poultry health, production, gut microbiome and AMR, food safety, alternatives to antibiotics and antimicrobial stewardship. Effective treatment can minimize losses and disease; however, unnecessary and repeated exposure could affect the microbial balance and favor resistant bacteria. Proper antibiotic use as part of a One Health strategy is critical to ensure optimal productivity of poultry and antimicrobial efficacy.

Keywords: antibiotic use, poultry production, AMR, gut microbiota, antimicrobial stewardship

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Introduction

The poultry industry is one of the major agricultural production sectors in livestock and an excellent source of animal protein in the form of meat and eggs. Poultry production has increased rapidly around the globe due to the growing human population and rise in the demand for poultry products. Good poultry health is necessary to maximize production, growth, and profitability. Bird health and performance can be negatively impacted by bacterial diseases [1,2]. As a result, disease control and prevention are critical to taking care of sustainable poultry production. Thus, appropriate use of antibiotics in poultry for the treatment and control of susceptible bacterial infections may be helpful in reducing disease-related morbidity, mortality, and production losses [3,4]. However, over-use of antimicrobials, such as unnecessary routine and growth promotion use, can create selection pressure among bacteria and promote antimicrobial resistance (AMR). Resistant bacteria and resistant genes can survive and spread in poultry, the farm environment, food products, and other parts of the production chain and pose a risk to animal health, food safety, and public health [5].

Use Of Antibiotics in Poultry Production.

Antibiotics can be used for therapeutic purposes to treat bacterial infections, to prevent the spread of disease in a herd where it is found, and for some production conditions as a preventative measure. In the past, some antimicrobials were also added to feed at low levels to enhance growth and production yields. The use of these varies depending on disease prevalence, farm management, production system, access to veterinary services and regulatory practices. The most frequently reported uses of antimicrobials for poultry farmers were therapeutic use, although preventive use and growth or productivity use were reported in a systematic review. In addition to disease prevalence, veterinary knowledge, perceptions, economics, and availability of veterinary advice all have an impact on the use of antimicrobials by farmers [1,3]. Examples of inappropriate use include incorrect drug selection, insufficient dosage, unnecessary combinations, unnecessary use of a drug beyond the normal period, or failure to observe periods without drug use. They can impact treatment effectiveness and selection for resistance [4,6].

Effect of Antibiotics on Poultry Health

Bacterial infections can be managed by the appropriate use of antibiotics, but broad-spectrum or frequent usage can also affect the healthy gut flora essential to good digestion, immune function, and gut health. This disruption can kill off susceptible bacteria and allow for less susceptible or resistant bacteria to thrive [7,8]. Antibiotic exposure could impact the intestinal microbial composition and hence, the intestinal barrier and immune functions of broilers. The relationship between gut health and growth, disease resistance and productivity should be considered, as effects beyond treatment should be considered [7,9]. The impact on the gut microbiota is dependent on the antimicrobial class, dose, duration, route, bird age, and the pre-existing gut microbiota. As a result, treatments don't necessarily have the same biological effects, and it's important not to use unnecessary, broad-spectrum therapy and to choose the narrowest possible therapy if possible [8,9].

Effect on Poultry Production

To support the productive performance of poultry, gastrointestinal health, efficient nutrient utilization, sufficient immunity, and low disease pressure are important factors. Intestinal damage and inflammation can decrease nutrient uptake, and anorexia and mortality can be caused by bacterial infections. With bacterial disease, therefore, the use of suitable antibiotic treatment can enhance production [1,2]. Historically, subtherapeutic antibiotics have promoted growth and feed efficiency, but the global problem of AMR has led to a decrease in their use and efforts to find alternatives. Biosecurity, vaccination, proper nutrition, environmental management, and non-antibiotic feed additives are all tools that can be used to maintain productivity without relying on antimicrobials [10,11].

Antibiotics, Gut Microbiota and Intestinal Health

There are various types of beneficial, neutral, and even pathogenic microorganisms present in the gastrointestinal tract of poultry. This microbiota plays a role in nutrient metabolism and fermentation, immune development, and protection against enteric pathogens. These interactions can be disturbed due to antibiotic exposure and change the composition and function of microbes [7,9]. Classic antibiotics may be another management variable that can influence the poultry microbiome, such as birds raised without the regular use of antibiotics can exhibit distinct intestinal microbiome dynamics from conventionally raised birds. The significance of the changes varies with the organisms involved and their effects on the host [8]. The resistome corresponds to all the genes encoding antimicrobial resistance genes found in a microbial community, and its composition can also be affected by exposure to antibiotics. Use of resistant organisms in selection and maintenance programs can promote the transfer of resistance to AMR from one pool of bacteria to another, such as the poultry intestine [5,9].

Antimicrobial resistance in poultry

One of the main risks of inappropriate use of antibiotics is antibiotic resistance. Repeated exposure may result in a higher proportion of organisms that are resistant when exposed to antimicrobials, because they are not affected [1,5]. Exposing organisms to antimicrobials can reduce the numbers of susceptible organisms, and if an organism is resistant, it will survive and replicate, increasing the proportion of resistant organisms in the population. Resistance can develop by the action of destroying the drug, altering the target, decreasing the permeability of the membrane, and/or actively pumping the drug out of the cell. There can be horizontal gene transfer of resistance genes as well [2,4]. Poultry-associated Escherichia coli, Salmonella, Campylobacter, and Enterococcus are important bacteria in the context of AMR. They can also be vectors of disease or carriers of resistance genes, and multidrug-resistant strains can make the treatment of bacterial diseases more challenging and expensive and make treatment failure more likely [1,9].

Food Safety and Public Health

Foods like poultry meat and eggs may be contaminated with bacteria like Salmonella, Campylobacter, and E. coli. If these organisms have antimicrobial-resistance determinants, the infections that result may be more difficult to treat. A 2025 systematic review and meta-analysis of bacterial pathogens in table eggs found that there was persistent antimicrobial resistance in Salmonella and E. coli isolates, while highlighting the food safety and antimicrobial stewardship areas [12]. The poultry production chain is thus part of the broader context of AMR in One Health. Resistant organisms can spread to humans directly, by environmental exposure, via food handling or food consumption of contaminated products. The proportion of poultry to human AMR, however, depends on the bacteria, the mechanism of resistance, production systems, geographic location, and exposure routes [13,14].

Another food-safety issue is from antibiotic residues. Drugs can stay in edible tissues or eggs if improperly given or if there is a failure to observe withdrawal periods. Inappropriate use, lack of regulation and monitoring have been cited as factors that raise concerns about residues and resistant bacteria in reviews from developing countries [13]. The withdrawal time indicated for each treatment and formulation should be adhered to, and good treatment records kept by farmers. Marketing meat before the proper holding period or marketing eggs before the proper holding period can lead to food safety issues and/or regulatory or economic ramifications [13,15].

Alternatives to Antibiotics

Minimizing the use of antibiotics should be about preventing disease and only using antibiotics when they are needed. Probiotics may help the health of the intestine by competitive exclusion, antimicrobial activity, immunomodulation, and maintenance of microbial balance, but these activities differ in effectiveness depending on the strain, dosage, diet, and production method [16]. Prebiotics feed beneficial bacteria, and synbiotics are made up of both probiotics and prebiotics and can help keep the gut healthy and may aid in resistance to pathogens [10,17]. They can be herbs, essential oils, spices or polyphenols, and have antimicrobial, antioxidant, anti-inflammatory and immunomodulatory properties; however, the properties depend on their composition, dosage and management [18,19]. Other types of bioactive compounds are under research, such as organic acids, postbiotics, parabiotic and antimicrobial peptides, but need further field testing for efficacy, safety and cost, as well as consistency [10,20].

Antimicrobial stewardship in Poultry Farms

Antimicrobial stewardship is responsible for the use of antibiotics to ensure they are effective for current and future generations. This is particularly important when considering the use of antibiotics in poultry farms; their use is only warranted when there is a specific need, the choice of the drug, its dose and duration, and the avoidance of unnecessary drug combinations [4,6]. Stewardship is based on the prevention of disease. Farm entry controls should be maintained, farm housing should be cleaned and disinfected, litter should be managed, clean water should be provided, rodent and insect control should be exercised, and overstocking densities in the barn should be avoided. There should be a correlation between major farm disease risks and vaccination [1,10]. Education for farmers is important. So, they should not take any of their own or non-professional advice but seek professional guidance [3]. There are stewardship actions that can be taken on a targeted basis that can be directed by farm records and resistance surveillance.

Future Perspectives and Conclusion

Sustainability of poultry antimicrobials and productivity will be essential to future poultry production. Precision farming, nutrition technologies and targeted therapeutics, rapid diagnostics and microbiome research may improve disease management and reduce the need for broad-spectrum treatment. A coordinated One Health framework is needed as the impact of AMR can span animal, human, food and environmental interfaces. In future AMR-control strategies, integrated surveillance and information sharing should, therefore, play a key role. Antibiotics will continue to be valuable when bacterial infections warrant antibiotic therapy, but their value will rely on the judicious use of antibiotics so that they are effective. Avoiding unnecessary antimicrobial use and AMR risk is possible with a combination of prevention-oriented production, evidence-based therapy, surveillance, farmer education, and integrated health management strategies that will keep production going.

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