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Mini Review

Transmission of Antimicrobial Resistance Through Animal-based Food to Humans: A Possible Hazard

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Abstract

Antimicrobial resistance (AMR) is a huge concern to humans, animals, and the environment across the world. Food source has a significant role in AMR's microbes' growth and dissemination. The AMR bacteria enter the food chain and pose a risk of infection to everyone. Animal Food containing antimicrobial-resistant microbes can cause sickness in humans when consumed by them. These and other species might provide transferrable resistance determinants for other microbes, including human diseases. The potential route for the spread of antibiotic-resistant bacteria in animals is feed, people, water, air or dust, soil, wildlife, rodents, arthropods, and equipment. The entry of AMR into the food chain is a major public health problem. As well antibiotic usage and abuse as growth boosters or general infection prevention and treatment in farm animals have increased antibiotic consumption and resistance among microorganisms in the animal environment. Through food intake and direct or indirect interaction, this reservoir of resistance can be conveyed directly or indirectly to people. Moreover, the selection and multiplication of antibiotic-resistant organisms can be transmitted to the environment through animal waste, thus augmenting the resistance reservoir in the environment microbiome. This review focuses on the role of animal-based food in transmitting AMR in the food chain.

Keywords: Food Pathogens; Antibiotic Resistance; Farm Animals; Human Transmission Food Safety

Introduction

There is a huge global demand for protein-rich food, which intensified the bulk production of animals to fulfil that demand [1]. Antimicrobials are often used to treat infections, prevent ailments, and stimulate growth in animals [2]. Antibiotics provide benefits but also lead to AMR, which is a global threat to human and animal health and has major economic and public health [3]. Antimicrobial resistance (AMR) is obtrusive and is recognized as one of the most relevant global fitness challenges of the twenty-first century through major international fitness corporations [4]. Microorganisms evolve through time, by their genes mutation or by acquiring antibiotic resistance plasmid through horizontal gene transfer, and in turn, do not respond to antibiotics [5]. AMR poses a challenge to effective infection prevention, treatment, and a wider variety of illnesses. Antimicrobial resistance refers to a microbe's capacity to survive and grow in the presence of drugs meant to kill or inhibit them. In 2013, an estimated 131,109 tons of antimicrobials were used in food animals, with that number antimicrobial use is expected to increase to 200,235 tonnes by 2030 [6]. Hence, an effective multidisciplinary approach including people, animals, plants, and the environment is required, to overcome AMR in animals. As we cannot ban the use of antibiotic in animal husbandry because it will increase the chances of disease in livestock. Thus, it is essential to focus on the transmission of bacterial resistance, through animal food in humans and the environment.

Antimicrobial resistance in bacteria from animal-based foods

Antimicrobials have been utilised in animals for illness treatment, disease prevention, and disease control, as well as growth stimulants. Antimicrobials have also been shown to be critical for long-term livestock productivity and the management of animal illnesses that might be transmitted to people" [7]. Nonetheless, antibiotic abuse or misuse has been blamed for the selection of resistant isolates, giving rise to the phrase antimicrobial resistance [8]. Antimicrobial resistance is a complicated and non-victimless process that affects both human and animal health, making the relationship between usage and abuse of antibiotics and resistance difficult to trace. Cattle, poultry, and pigs have all been extensively grown across the world, not only as a source of food but also as a source of revenue. Due to the constantly rising demand for animal products caused by human population increase and urbanisation

[9,10], the ways of production are intense [11]. This has forced the use of antimicrobials without restriction, which has been linked to a rise in antimicrobial resistance [12,13].

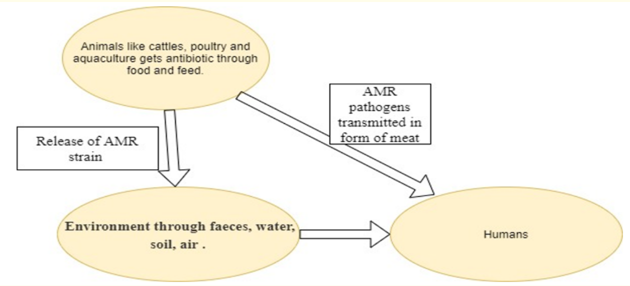

Figure 1: Shows the Inter transmission of AMR in three heads that is animals, humans, and the environment.

AMR transmission through poultry

Poultry is among the most diverse food sectors in the world. A substantial risk of AMR development is associated with the poultry farming system. Antimicrobials are used to boost poultry in virtually every worldwide location, most usually by the oral route, to save and treat sickness, as well as preventing epidemic transmission in livestock and enhancing development and production. Such indiscriminate antibiotic use in animal agriculture is likely to accelerate the development of AMR in pathogens as well as commensal bacteria. Human concerns about the presence of antibiotic residues in meat and eggs have arisen because of the advent of AMR in bacteria from poultry production [14]. Antimicrobial-resistant poultry infections can cause treatment failure, resulting in financial losses, but they can also be a source of resistant bacteria/genes, posing a health risk to humans. Avian pathogenic *Escherichia coli (APEC)* [15,16], *Staphylococcus neoformans* [17,18], *Salmonella pullorum/Gallinarum* [19], *Pasteurella, Multocida, Avibacterium paragallinarum, Bordetella avium,* and other bacterial strains have shown AMR in poultry. *Salmonella* has a greater prevalence of AMR than other bacteria [20]. There are several additional pathogenic and opportunistic diseases associated with poultry and monitoring the microbiome and resistome of these animals can help in better understanding the ecology and prevalence of AMR microbial hosts [21]. Furthermore, huge application of antimicrobial drugs is typically used to overcome biosafety management flaws, allowing for larger MDR bacteria loads in small stakeholder livestock production [22].

Though there are many challenges in the prevention of MMR in poultry is that most persons who run small-scale intensive operations use antimicrobials in commercial feed and water to raise broiler or layer chicken. Due to a lack of antimicrobial resistance awareness, attention, and access to excellent veterinary care, several studies have indicated that improper and irrelevant use of antimicrobial medicines is frequent within family-run systems. Intensive family businesses frequently lack the industrial assets that are available in commercialised enterprises to assist with basic biosafety standards.

Antimicrobial resistance in dairy products

Milk, the most popular natural health food, is consumed by people of all ages across the world. This is the foundation for the development of dairy farming and industry [23]. Dairy animals are also raised for meat in addition to milk. Given that dairies often employ more antimicrobials, observational studies of livestock production systems usually find that cattle from traditional dairies retain a greater incidence of antimicrobial-resistant enteric bacteria than cattle from natural (organic) dairies or red meat producers. *Staphylococcus aureus, Escherichia coli, Listeria monocytogenes*, *Salmonella spp*., and other resistant pathogenic pathogens are the most observed in dairy production. *S. aureus* is one of the most common causes of food poisoning. Enterotoxigenic strains of *S. aureus* are frequently found in milk and dairy products. *S. aureus* is commonly found on the skin and mucosae of animals and is typically linked with subclinical mastitis, which allows it to enter the milk supply chain [24]. *L. monocytogenes* is also a resistant bacterium that is commonly found in dairy products. Antimicrobial-resistant enteric bacteria, primarily *E. coli*, have also been found in the feces of healthy breastfeeding dairy cows [25]. MDR *E. coli* bacteria that produce Shiga toxin have also been discovered from cow dung swabs in Calcutta, India [26]. Similarly, a few investigations have documented the presence of *E. coli* generating extended-spectrum -lactamases in food-producing animals from Canada [27], India [28] and, Europe [29].

Manure pits are also a source of AMR and are used to hold enormous volumes of raw excrement combined with worn bedding materials and wastewater on dairy farms where animals are confined. The levels of AMR in *E. coli* from manure pits were not different from those reported in adult cows, even though there were fewer bacteria (difference in volume dilution for cows and manure pits). Commercial spreading of dairy excrement can propagate AMR genes into the environment [30].

Discussion: Antibiotic usage in food animals over lengthy periods generates optimal circumstances for the creation and spread of resistant strains. Food, water, dirt, and dung, which are used as fertilizers, can all include resistant germs that can reach humans directly or indirectly. There is indisputable proof that a substantial number of resistant bacteria are present in meals from numerous animal sources and at all phases of food processing. In the most prevalent food-borne diseases, such as *E. coli* and *Salmonella*, different forms of enterococci, and methicillin-resistant Staphylococcus aureus, homologous links between drug-resistant bacteria in humans and animals have been established (MRSA).

The problem in the prevention of AMR is little awareness of antibiotics among farmers and are mostly unaware of the idea of antimicrobial resistance. Dairy producers cure animals on their own using outdated prescriptions due to a lack of appropriate veterinary services and the high expense of treatment. Irrational use of antibiotics, by farmers is resulting in an increase of AMR in food pathogens. As a result, veterinary human resources must be strengthened as soon as possible. Other treatments, such as community awareness initiatives about antibiotics, antibiotic resistance, and zoonotic infections, are needed to raise awareness and address a variety of challenges. Legislation must be drafted to prohibit the selling of antibiotics over the counter without a veterinarian's prescription. With all these measures, we can prevent the spread of AMR through food (Animals) to Humans and Environment.

Conclusion

Antimicrobial resistance is a major public health problem across the world. Antibiotic overuse in animals, are substantial contributors to antimicrobial resistance. To reduce the overuse of veterinary antibiotics, they must be utilised sensibly through therapeutic preventative approaches in most situations. Integrated farming organisations should employ immunizations, veterinary herbal medicine, and other methods to limit the usage of antimicrobials. Regular training on the judicious use of antimicrobials, improved antimicrobial stewardship, and tight infection control measures are all required at the same time. Reduced use of unneeded antimicrobial drugs may aid in the prevention of the establishment and spread of drug-resistant microorganisms. Finally, to combat AMR through food chain multidisciplinary approach should be preferred.

Conflict of Interest

The authors declare that they have no conflict of interest concerning the research, authorship, and/or publications of this article.

Bibliography

1. Tian M., *et al*. "Pollution by Antibiotics and Antimicrobial Resistance in Livestock and Poultry Manure in China, and Countermeasures". *Antibiotics (Basel)* 10.5 (2021): 539.
2. Sengupta., *et al*. "Opportunities to Overcome Implementation Challenges of Infection Prevention and Control in Low-Middle Income Countries". *Current Treatment Options in Infectious Diseases* 11(2019): 267-280.
3. O'Neill J. "Tackling Drug-Resistant infections globally: Final report and recommendations". (2016).
4. Bennani H., *et al*. "Overview of evidence of antimicrobial use and antimicrobial resistance in the food chain". *Antibiotics (Basel)* 9.2 (2020): 49.
5. Munita JM and Arias CA. "Mechanisms of Antibiotic Resistance". *Microbiol Spectr* 4.2 (2016): 10.1128.
6. Van Boeckel TP., *et al*. "Reducing antimicrobial use in food animals". *Science* 357.6358 (2017): 1350-1352.
7. World Health Association. "The medical impact of the use of antimicrobials in food animals". *World Health Organization* (1997).
8. Davies J and Davies D. "Origins, and evolution of antibiotic resistance". *Microbiology and Molecular Biology Reviews* 74.3 (2010): 417-433.
9. Schar D., *et al*. "Surveillance of antimicrobial consumption in animal production sectors of low- and middle- income countries: optimizing the use and addressing antimicrobial resistance". *PLoS One* 15.3 (2018): 1-9.
10. Ayukekbong JA., *et al*. "The threat of antimicrobial resistance in developing countries causes and control strategies". *Antimicrob Resist Infect Control* 6.1 (2017): 1-8.
11. Ilea RC. "Intensive livestock farming: global trends, increased environmental concerns, and ethical solutions". *Journal of Agricultural and Environmental Ethics* 22 (2009): 153-67.
12. Alonso CA., *et al*. "Antibiotic resistance in Escherichia coli in husbandry animals: the African perspective". *Letters in Applied Microbiology* 64 (2017): 318-34.
13. Kimera ZI., *et al*. "Antimicrobial use and resistance in food-producing animals and the environment: an African perspective". *Antimicrob Resist Infect Control* (2020).
14. Goetting V., *et al*. "Pharmacokinetics of veterinary drugs in laying hens and residues in eggs: a review of the literature". *Journal of Veterinary Pharmacology and Therapeutics* 34 (2011): 521-56.

15. Tadesse DA., *et al*. "Antimicrobial drug resistance in Escherichia coli from humans and food animals, United States, 1950-2002". *Emerging Infectious Diseases* 18 (2012): 741-9.

16. Simoneit C., *et al*. "Oral administration of antimicrobials increase antimicrobial resistance in E. coli from chicken-a systematic review". *Preventive Veterinary Medicine* 118 (2015): 1-7

17. Bortolaia V., *et al*. "Human health risks associated with antimicrobial-resistant enterococci and Staphylococcus aureus on poultry meat". *Clinical Microbiology and Infection* 22 (2016): 130-40.

18. Silva V., *et al*. "Prevalence and Characteristics of Multidrug-Resistant Livestock-Associated Methicillin-Resistant *Staphylococcus aureus* (LA-MRSA) CC398 Isolated from Quails (*Coturnix Coturnix Japonica*) Slaughtered for Human Consumption". *Animals* 11.7 (2021): 2038.

19. Luna-Galaz GA., *et al*. "Antimicrobial sensitivity of Avibacterium paragallinarum isolates from four Latin American countries". *Avian Diseases* 60 (2016): 673-676.

20. Nhung NT., *et al*. "Antimicrobial Resistance in Bacterial Poultry Pathogens: A Review". *Frontiers in Veterinary Science* 4 (2017): 126.

21. Mottet A and Tempio G. "Global poultry production: Current state and outlook and challenges". *World's Poultry Science Journal* 73 (2017): 245-256.

22. Graham J.P., *et al*. "Small-Scale Food Animal Production and Antimicrobial Resistance: Mountain, Molehill, or Something in-between?" *Environmental Health Perspectives* 125 (2017): 104501.

23. Sharma C., *et al*. "Antimicrobial Resistance: Its Surveillance, Impact, and Alternative Management Strategies in Dairy Animals". *Frontiers in Veterinary Science* 8.4 (2018): 237.

24. Normanno G., *et al*. "Methicillin-resistant *Staphylococcus aureus* (MRSA) in foods of animal origin product in Italy". *International Journal of Food Microbiology* 117.2 (2007): 219-22.

25. Sawant AA., *et al*. "Antimicrobial-resistant enteric bacteria from dairy cattle". *Applied and Environmental Microbiology* 3.1 (2007): 156-163.

26. Khan A., *et al*. "Antibiotic resistance, virulence gene, and molecular profiles of Shiga toxin-producing *Escherichia coli* isolates from diverse sources in Calcutta, India". *Journal of Clinical Microbiology* (2002).

27. Massé J., *et al*. "Prevalence of Antimicrobial Resistance and Characteristics of *Escherichia coli* Isolates from Fecal and Manure Pit Samples on Dairy Farms in the Province of Québec, Canada". *Front Vet Sci* 8 (2021): 654125.

28. Sharma G., *et al*. "A qualitative study on antibiotic use and animal health management in smallholder dairy farms of four regions of India". *Infect Ecol Epidemiol* 10.1 (2020): 1792033.

29. European Food Safety Authority European Centre for Disease Prevention and Control. "The European Union Summary Report on Antimicrobial Resistance in zoonotic and indicator bacteria from humans, animals, and food in 2017/2018". EFSA J. 18.3 (2020): 3.

30. Wichmann F., *et al*. "Diverse antibiotic resistance genes in dairy cow manure". *Mbio.* (2014) 5: e01017-13.

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