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Addressing antimicrobial resistance through organic livestock farming: An overview

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Abstract
Global health is increasingly at risk due to advent of antimicrobial resistance (AMR). This increase in AMR is a result of the negligent use of antibiotics primarily in human and animal medicine, livestock farming and aquaculture. However, by strictly regulating the use of antibiotics and improving animal health through organic methods, can help reduce the hazards of AMR. This review examines the effects, benefits, and challenges of organic livestock farming in the fight against AMR.

Keywords: Antimicrobial resistance, AMR, Organic livestock farming, Antibiotics

1. Introduction

Antimicrobial resistance is a serious health concern worldwide. The imprudent use of antimicrobials in humans, animals, and plants drives the development of bacterial resistance against drugs. This worsen the situation making infections harder to treat with available antimicrobials, often requiring costly treatment, and leads to higher mortality and morbidity rates amongst the population [75]. The World Health Organization (2023) ranks AMR among the top ten global health risks, with an estimated 1.27 million deaths in 2019 linked to AMR, contributing to 4.95 million deaths worldwide [3]. Beyond deaths and disabilities, AMR places a heavy strain on the economy. The World Bank predicts that by 2050, AMR could add US$ 1 trillion to healthcare costs, and cause yearly GDP losses of US$ 1–3.4 trillion by 2030 [26].

A large proportion (50 – 80%) of antibiotics is used in livestock raised for food for non-medical reasons [11, 68]. Farmers often use antibiotics in livestock production as growth promoters [42, 55]. This low-dose long-term antibiotic use creates ideal conditions for the development and dissemination of antibiotic-resistant bacteria [18]. The widespread use of antibiotics in conventional practices, mainly in intensive farming, has played a significant role in the rise and spread of resistant bacteria [52, 51, 6, 27].

In recent years, people have become more concerned about how antibiotic use in livestock might cause human antibiotic treatments to fail [74]. To tackle this problem, organic livestock farming has emerged as a promising sustainable option that could help reduce AMR.

The fundamentals of organic livestock production

Organic livestock production is established using a holistic approach that integrates environmental stewardship, animal welfare, and sustainable farming practices. This adheres to stricter guidelines prohibititing the routine use of antibiotics. Instead, this focuses on preventive measures, such as improved hygiene, balanced nutrition, use of organic feed, lower stocking densities, outdoor access to animals, and other animal welfare measures to maintain and promote better animal health and minimize stress and disease susceptibility in animals.

This reduces the number of infections that require antibiotic therapy [54, 28, 32]. The fundamental ideas guiding organic livestock production in terms of addressing the problem of antibiotic resistance are as follows:

Natural and organic feed: Livestock must be fed with physically grown 100% organic feed [67, 4], with more than half coming from farms or other local sources, to ensure that the animals ingest natural, high-quality nutrients that can improve their health and reduce the need for medical interventions [7]. There should be provisions for adequate clean, potable water and green fodder. This forbids the use of artificial growth promoters, appetizers, preservatives, coloring agents, amino acids, emulsifiers, and urea [9]. Although it has not yet been demonstrated that animals rose organically are healthier than those raised conventionally, organic standards provide a useful framework for managing the health and welfare of animals [28].

Animal welfare and ethical treatment: Ensuring high standards of animal welfare is the cornerstone of organic livestock production. Animals are provided with optimal living conditions that favor natural behaviors, including appropriate shelter, adequate space, minimal confinement, and access to the outdoors. Such practices are implemented to enhance animal well-being [31, 71].

Minimal use of synthetic inputs: Organic farming strictly

restricts the use of synthetic inputs, including antibiotics and hormones. Antibiotics are used as a last resort when necessary only to treat illness rather than being used as growth promoters or preventive measures. This helps mitigate the development of AMR [47].

Health and disease prevention: Organic livestock production emphasizes preventive health measures above therapeutic ones. Genetic selection for disease resistance, immunization, balanced nutrition, and stress reduction are all desirable strategies for maintaining health and preventing disease [39]. This prophylactic approach minimizes the need for antibiotics and other synthetic drugs [53].

Adhering to these principles, the long-term benefits in terms of animal health and reduced AMR make it a compelling alternative to conventional farming practice.

Impact of conventional livestock production on AMR

Conventional livestock farming methods have a huge impact on how AMR commences and spreads because they rely heavily on antibiotics. In the usual setup, farmers use antibiotics not only to treat sick animals, but also to help them grow faster and stay healthy on congested farms [15]. This pervasive and sometimes casual use of antibiotics is the main reason for the development of AMR. This exerts pressure on bacteria to change, grow, and spread in ways that make them resistant to antibiotics [51, 68].

The use of antibiotics to accelerate animal growth has caused much debate. Some areas have prohibited or restricted this practice, but it is nevertheless popular in many parts of the world [56]. This sub-therapeutic use of antibiotics to promote faster growth and increase feed efficiency produces a constant selective pressure that favors the emergence of resistant bacteria.

Environmental contamination from conventional livestock production also aggravates AMR. Manure from such animals (antibiotic-treated) can contain high levels of drug residues and resistant bacteria, which contaminate soil and water bodies when used as fertilizer or through waste runoff [57]. This spread in the environment helps resistance genes move between groups of bacteria, which increases resistance [58].

In addition, when animals are kept close together in conventional systems, they are more likely to become sick. This leads farmers to use antibiotics to stop infections. This preventive treatment significantly increases the total consumption of antibiotics in livestock farming [5]. These crowded systems create an ideal setting for the dissemination of infectious diseases and resistant bacteria [51]. The problem worsens when resistant bacteria shift from farm animals to humans through food and the environment [73]. Research shows that places where people use a lot of antibiotics, such as large livestock farms, have more bacteria that are resistant to antibiotics [35]. These resistant bacteria can spread from animals to humans by direct contact, consumption of contaminated food, and environmental pathways such as agricultural runoff. This interconnectedness shows how human, animal, and environmental health are all linked and highlights the serious need to adopt sustainable practices, enforce strict rules, and take a One Health approach to fight this global health risk [29, 48].

Reduced antimicrobials usage in organic livestock production

Reduced use of antimicrobials is a hallmark of organic animal husbandry practices, reflecting its philosophy of sustainability, animal welfare, and human well-being. In organic livestock farming, apart from exceptional circumstances, antibiotics are permitted solely for therapeutic purposes as a last resort for the treatment only [4, 18]. This is a critical part of tackling AMR, as it markedly decreases the total antibiotic use in livestock farming. Research also has exemplified the reduction in antibiotic-resistant bacteria on organic farms, indicating the efficacy of organic methods in combating AMR [69]. However, there is a significant context-dependent variation in this pattern [2].

Preventative health is a primary focus and therefore major reason for the reduced usage of antibiotics in organic livestock farming. This is preferred by practices such as genetic selection for disease resistance and nutritional balance. For example, ensuring that animals are provided with high-quality feed and adequate living conditions that can help minimize stress and predisposition to disease, and minimizing the need for antibiotics [39, 53].

Better animal husbandry procedures in organic production result in fewer use of antibiotics. These organic standards include outdoor access to animals, adequate space, and opportunities to express natural behaviors, which are known to reduce the likelihood of stress-related diseases [31]. As a result of superior welfare conditions, livestock are in a better overall condition and do not usually require routine antibiotics, as is common in conventional, especially intensive, farming systems. Also, the stringent organic regulations, further restricts the application of such substances, thereby lowering animal exposure to antibiotics, and reduced risk for AMR [47].

Sustainable land management practices including integrated cropping-livestock systems and rotational grazing etc also contribute to reduced use of antibiotics in livestock production. These practices, regularly employed in farms, can assist in eliminating the presence and buildup of pathogens in the farm environment [20, 19] and improves the resilience and the need for therapeutic interventions.

The use of alternative therapies such as herbal medicines, homeopathy, use of probiotics, and natural remedies also supports the reduced use of antibiotics. Organic standards encourage the use of holistic treatments, to maintain health and treat minor illnesses in animals [23, 22].

Abridged use of antibiotics in livestock production has reward that extend beyond the farm. It is evident by the studies that organic systems reflects in lowered antibiotic residues in animal products [28, 45] and decreased prevalence of drug-resistant bacteria in animals and environment compared to conventional systems [37, 25].

These measures not only improve animal-public health safety and welfare, but also help in fighting the battle against AMR.

Benefits of organic livestock production in mitigating AMR

The comprehensive approach to organic livestock production is multifaceted and aids in the combat against AMR in a several ways.

One of the biggest rewards of organic livestock farming is

its stringent rules regarding antibiotic usage restricting antibiotics as a last resort treatment only [47]. This reserved use of antibiotics results in a lower chance of development and spread of drug resistant bacteria.

It is evident that, organic farms have fewer antibiotic-resistant bacteria, which further lower the chance of spread to human beings [35]. This reduced risk of transmission is key to public health, as it helps control the spread of robust infections that are difficult to treat and manage [48].

Organic farming endorses the use of other options, such as herbal medicine, homeopathy, and probiotics, to keep animals healthy and treat minor illnesses [22]. Although their usefulness is contentious, alternative medicines are currently considered one of the strategies to reduce antibiotic use in livestock production. These alternate treatments can address health concerns without generating or contributing to the spread of AMR. Supporting natural cures and holistic health practices is consistent with the idea of organic farming, which seeks to limit antibiotic use.

In addition, organic farms promote natural methods for keeping animals healthy providing them with balanced food, adequate space, and access to the outdoor. Organic livestock farming focuses on animal welfare practices, which help reduce stress and, hence, disease vulnerability among animals, thereby reducing the need for antibiotics [17]. Improved animal welfare in organic livestock farming is also related to better immune systems, which reduces dependence on antibiotics for disease control and prevention and help fighting AMR [31, 13].

Sustainable land management methods such as rotational grazing, crop rotation, and integrated livestock and crop farming boosts soil health and biodiversity [20]. These methods often use sustainable practices that reduce pathogen numbers, eventually curbing the need for antibiotics. In addition, proper manure management in organic farming help reduce environmental pollution from antibiotic residues and resistant bacteria in manure and help stop the spread of resistant bacteria in nature [28, 36, 30]. Restrained use of antibiotics, also leads to less antibiotic residues and drug-resistant bacteria polluting the environment [57]. These practices help create better ecosystems that prevent the spread of resistant genes amongst bacteria making them resistant to antibiotics [10].

Moreover, following rigorous production standards with restricted use of antibiotics, organic products, are a safer choice that aligns with consumer concerns about the health risks and safety linked with presence of drug-resistant bacteria in food of animal origin [68]. In this, organic certification of products builds trust as this assures consumers that the products are sourced from animals raised without antibiotics [70].

These methods considerably reduce the development and spread of antibiotic-resistant bacteria.

Challenges and limitations

Despite of offering several benefits, including the ability to fight AMR, organic livestock farming often faces obstacles that prevent its extensive implementation in practice. Managing diseases can be a more complex due to restrictions on antibiotic use in organic systems. Farmers have to employ alternative treatments and preventive measures which may not always be effective or accessible [41, 72]. Especially, in the wake of disease outbreaks, restricting the use of antibiotics can cause more animals to become sick and die of the disease creating significant burden and welfare issues in raising livestock [5].

Furthermore, the escalated cost of raising livestock organically, due to additional manual labor, prohibition of synthetic inputs etc. is one of the biggest impediments to organic livestock farming making it more expensive than conventional feed [10, 44, 16]. These increased expenses would limit the market share of organic products and may slow down market expansion [28, 1, 34].

Also, the transition from conventional practices to organic livestock farming is complicated and often takes time. It requires considerable adjustments to the setup and operation of farms [76, 9, 33].

In addition, when compared to conventional systems, organic livestock farming may experience slower growth rates, lower yields and decreased productivity as a result from the absence of synthetic inputs such as antimicrobials [9, 47, 49] presenting a unique challenge in satisfying the growing global demand for and livestock products [50].

Although organic products are becoming increasingly popular, local consumer awareness and demand vary greatly [38] resulting less likely purchase of organic products [46] and consequently, less motivation to adopt organic production practices for farmers [40].

In addition, despite its eco-friendly reputation, organic farming can influence the environment in negative sense when not managed sustainably. It can contribute to issues such as greenhouse gas emissions, soil erosion, and more water consumption etc. [20]. The organic sector faces a critical challenge: balancing its environmental benefits with the need to create productive and effective farming systems.

Besides these, addressing existing challenges such as improved disease management, development of more effective alternative therapies, and increased sustainability, organic livestock production requires additional research and development. However, limited funding has always been an important constraint, which slows the pace of innovation and adoption of new ideas and their implementation.

Addressing these challenges may help organic livestock production reach its full potential in reducing AMR.

Future directions and research needs

The roadmap for organic livestock farming plays a key role in addressing existing issues of antimicrobial resistance and boosting its ability to tackle the threat. Researchers need to conduct long-term studies to assess the effectiveness of organic practices in lowering AMR [8]. Future efforts and studies should aim to improve disease management [22], create novel alternative treatments, boost animal health and well-being [31], balance nutrition management [43], promote sustainable soil and manure practices [21], upgrade farming methods, educate consumers, grow market demand, policy interventions, and support policies and regulations [12, 24], exercise One Health approaches [48], and invest in research and innovations.

Organic livestock farming practices fundamentally promote systems that lead to less antibiotic use; however, ongoing challenges underline the need for targeted research and development in this direction.

Conclusion

In conclusion, organic livestock farming presents a promising approach to curbing antimicrobial resistance by restricting antimicrobial use and improving animal health and production through sustainable natural methods. The enduring benefits in terms of public health, animal welfare, and environmental friendliness prevail over the drawbacks, such as higher costs and the requirement for specialized knowledge. Growing organic farming and addressing the global AMR threat all depend on ongoing research, policy support, and consumer education.

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