

Antibiotic Residues in Milk-A Threat to Food Safety and Quality

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Abstract

Across the world, the presence of antibiotic residues in animal-based food products is the major threat to the food safety and quality. The antibiotic residues in dairy products may lead to the occurrence of antimicrobial resistance among microorganisms or potent pathogens. The condition is more severe in developing countries like India due to lack of testing facilities, poor infrastructure at ground level, lack of education among the farmers and lack of awareness among the consumers. The consumption to milk and milk products contaminated by antibiotic residues should be stopped. Preventive measures should be taken to avoid the development of anti-microbial resistance among the pathogens.

Introduction

Food safety and quality is the matter of prime importance in recent times. Nowadays, the consumers are ready to pay more, for safe and high-quality food products. The food safety not only includes food free from adulterants but also from contaminants as well. Milk is the most consumed beverage across the globe. Milk is thought to be a complete food as it contains carbohydrates, fats, proteins, vitamins, and minerals in significant amount. Milk is consumed by people of all ages due to its pleasant taste, flavor, nutritional and therapeutic properties (Connie, 2010). Despite of huge nutritional availability the image of milk has been tainted in recent times because of presence of various adulterants and contaminants like antibiotics. India ranks first in milk production in the world but does not export the dairy products in significant amount because of not fulfilling the international food quality standards (Mohan, 2022). Food Safety and Standards Authority of India (FSSAI) has conducted a survey in 2019, showed that 77 samples (out of 6,432 samples) had antibiotics residues above the permissible limits (FSSAI, 2019), which means that the milk available throughout the country is largely safe with respect to

chemical adulterants, but the antibiotic residues in dairy products is a more serious problem than adulteration.

Antibiotics

Antibiotics are chemical substances naturally produced by microorganisms or synthetically, which at low concentration destroy or prohibit the proliferation of microorganisms resulting in minor or no host damage. In other words, antibiotics are chemical substances used to inhibit the growth of pathogens or diseases causing microorganisms. Antibiotics are the secondary metabolites of the microorganisms produced by the microorganisms to restrict the growth of other microorganisms.

Use of Antibiotics

In dairy animals antibiotics are mainly administered for the purpose of treatment of diseases, growth promotion and increased productivity. The use of antibiotics in animals has increased drastically. The use of antibiotics has transformed the dairy industry by offering several advantages including enhanced growth, increased production efficiency, obviating diseases, resulting in reduced prevalence of diseases, morbidity and mortality (Dafale *et al.*, 2016).

Antibiotic Residues in Milk

When any antibiotic is administered to the milch animal for treatment of disease or for prophylactic purpose the antibiotic residues gain entry in milk and get excreted out of the body of the animal through the route of milk. In this way the antibiotic residues gain entry into the milk. It is the one of the main reasons behind the entry of veterinary drug residues in the human food chain.

However, using antibiotics provides several advantages for the growth of dairy sector. On the other hand, indiscriminate use of antibiotics in farm animals leads to occurrence of antimicrobial residues in milk and thereby pose major food safety risk to consumers in terms of development of anti-microbial resistance

among the microorganisms and difficulties in processing of milk, like starter failure in fermented products.

Adverse Effects of Antibiotic Residues on Human Health

Antibiotic residues in milk and milk products poses various adverse health effects in humans which includes hypersensitivity reaction, carcinogenicity, teratogenicity, mutagenicity, nephropathy and disruption of normal intestinal flora. Antibiotic residues pose serious threats to human health as these residues may result in allergic reactions in hypersensitive individuals and may lead to emergence of anti-microbial resistance.

Maximum Residue Limit (MRL)

The maximum residue limit of antibiotic residue is the maximum concentration of residue legally permitted to occur in foods obtained from animals to which antibiotics are administered. In order to exert control on the problem antimicrobial residues in animal-based food products, the food safety authorities in many countries have established MRL. The food product containing antibiotic residues below MRL doesn't exert any significant effect on the health of the consumer. The problem arises when the MRL of the product is not followed due to lack of maintaining withdrawal time, poor infrastructure and lack of testing facilities at the ground level.

Economic loss to the Dairy Industry

The milk contaminated with antibiotic residues poses several problems to the dairy industry. The antibiotic residues containing milk shows more time in the MBRT test, which is used to estimate the microbial load of the milk. In this way the substandard milk may also pass the test. It also causes technical problems in dairy industry in the form of starter culture failures in case of fermented products (Kebede *et al.*, 2014), which leads to huge financial losses to the dairy industry. The antibiotic residues in milk are responsible for the slow fermentation process in dairy-based probiotic drinks. Microencapsulation is used to enhance the resistance of probiotics to unfavorable conditions (Kumari *et al.*, 2023).

Measures to Control Antibiotic Residues in Milk

Withdrawal Time- The withdrawal time is the necessary for the drug or antibiotic residues concentration to fall below the MRL. The withdrawal time of the antibiotics should be strictly followed in order to maintain food quality and safety.

Infrastructure Development- Proper infrastructure should be developed at the ground level to check the quality of the milk and ensure food safety, as shown in fig. 1. Testing of various products should be done regularly to prevent the sale of antibiotic residue containing products in the market.

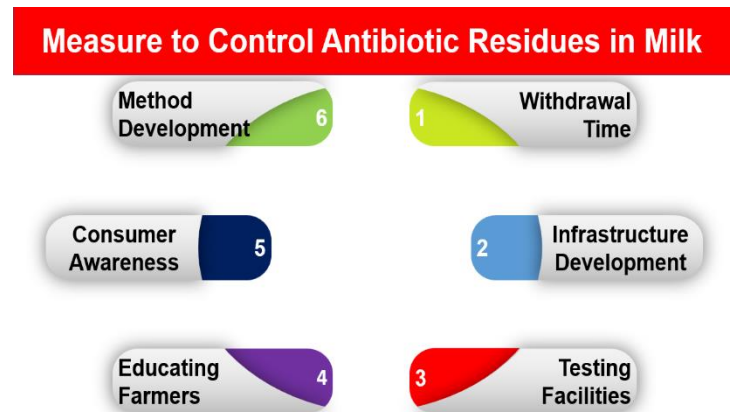


Fig. 1: Measures to control antibiotic residues in milk

Testing Facilities- There should be availability of testing facilities at grassroot level, so that the milk samples can be tested for antibiotic residues at the earliest stage.

Educating Farmers- There is lack of education among the farmers regarding the use of antibiotics as well as withdrawal time and MRL so in order to ensure production of antibiotic free milk the farmers/producers should be properly educated about the use and adverse health effects of antibiotic residues in milk.

Consumer Awareness - In developing countries like India there is lack of awareness among the consumers about the presence of contaminants in animal-based food products. Awareness among the consumers is necessary to prevent the use of milk containing antibiotic residues (Fig. 1).

Development of Rapid Methods- Some simple, inexpensive and rapid methods should be developed

to detect the antibiotic residues in raw milk at the time of procurement of milk so that the antibiotic residues containing milk is not pooled with safe milk.

Future Aspects

The problem of antibiotic residues in dairy products can lead to a global threat of anti-microbial resistance among some of the most potent pathogens, which may lead to some serious diseases with no cure at all. Also, the antibiotic residues in milk are responsible for huge monetary losses to the dairy processing industry. Considering these points, there should be more thrust on the research in this particular area to tackle the problem in a sustainable and effective manner.

Conclusion

With rapid increase in milk production, per capita availability and consumption, it is highly important to ensure that the milk supplied to consumers is of good quality to ensure the food safety. The milk should be free from adulterants as well as various contaminants like antibiotic residues. Antibiotic residues found in milk and milk products pose a significant threat to the safety of consumers and their detection in milk and milk products is essential to ensure compliance with the national and international regulatory standards. Some rapid strip-based test may be developed to check presence of antibiotic residues in milk in order to ensure the supply of milk having good quality to the consumers.

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