DRUG RESIDUES IN MILK AND MEAT: WHAT EVERY CONSUMER SHOULD KNOW

Pravin Maruti Madabhavi[1], Deepthi V[2], Supriya Yadav[3], Kanhaiya Lal[1], Rushikesh Mortale[4]

[1]Assistant professor, Division of Pharmacology & Toxicology, [2]Phd Scholar, Division of Pharmacology & Toxicology ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly,[3]Assistant professor, Division of veterinary Microbiology, [4]Assistant professor, Division of Poultry Science Shourabh College of Veterinary Science, Hindaun city, Rajasthan,

*Corresponding author's e-mail: *pravinmadabhavi1999@gmail.com*

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ABSTRACT

Milk and meat are essential components of diets worldwide, yet their safety is increasingly threatened by veterinary drug residues. These residues trace amounts of antibiotics, antiparasitic, painkillers, and hormonal agents enter food products when withdrawal periods are ignored or drugs are misused. Although often present in small quantities, they pose serious health risks, including antibiotic resistance, allergic reactions, toxic effects on vital organs, and hormonal imbalances. The article explains how residues pass into milk via the bloodstream and accumulate in tissues of meat-producing animals, highlighting the importance of withdrawal periods in ensuring food safety. Beyond health concerns, residues also affect the dairy and meat industries, leading to rejection of export consignments, economic losses, and erosion of consumer trust. Contributing factors include lack of farmer awareness, economic pressures, self-medication, and poor record-keeping. Regulatory frameworks such as those established by the Food Safety and Standards Authority of India (FSSAI) and Codex Alimentarius Commission, set maximum residue limits (MRLs), but lapses persist. The article emphasizes that food safety begins at the farm, requiring responsible drug use and adherence to good veterinary practices. Consumers also play a vital role by sourcing products from regulated markets and supporting safer farming systems, thereby protecting public health and sustaining industry credibility.

INTRODUCTION

Milk and meat are staple foods in households across the world, forming an essential part of daily diets. Because of their widespread consumption, ensuring their safety is a matter of public concern. Consumers should care deeply about what goes into these foods, as they are often produced from animals treated with medicines such as antibiotics, painkillers, and dewormers to maintain health and productivity. While these treatments are necessary, improper handling or failure to observe withdrawal periods can lead to small amounts of these drugs remaining in milk and meat products. These residues, though seemingly minimal, can accumulate over time and pose significant risks to public health. Long-term exposure has been linked to antibiotic resistance, allergic reactions, and even chronic conditions affecting the liver, kidneys, and cardiovascular system. Regulatory bodies like the World Health Organization (WHO) and Codex Alimentarius Commission have established permissible limits, but lapses in compliance still occur, making consumer awareness vital. By understanding the issue of drug residues, consumers can make informed choices, support safer farming practices, and advocate

for stronger food safety measures. This knowledge empowers households to protect their health while continuing to enjoy the foods they rely on every day.

WHAT ARE DRUG RESIDUES

Drug residues are trace amounts of veterinary medicines or their metabolites that remain in food products of animal origin such as milk, meat, eggs, and honey after animals have been treated with drugs. These substances include antibiotics, antiparasitic agents, painkillers, and anti-inflammatory drugs, which are widely used in modern livestock farming to prevent and treat diseases, improve animal welfare, and maintain productivity (Khalifa *et al*., 2020). Residues occur when farmers fail to observe the required *withdrawal periods* the time needed for a drug to clear from an animal's system before its products are consumed or when drugs are misused or overused. As a result, small but measurable amounts of these drugs can persist in edible tissues and milk, entering the human food chain (Shaikh & Patil, 2020).

Why They Matter

Even though residues are often present in very small quantities, they pose significant public health concerns, Long-term exposure has been linked to:

Antibiotic resistance: One of the most serious risks posed by drug residues is the development of antibiotic-resistant bacteria. Continuous exposure to low levels of antibiotic residues in food can select for resistant strains, which may then be transferred to humans. This makes common infections harder to treat and reduces the effectiveness of essential antibiotics (Pal *et al*., 2025).

Allergic reactions: Certain individuals are hypersensitive to specific drugs, such as penicillin. Even trace residues in milk or meat can trigger allergic responses ranging from mild skin rashes to severe anaphylactic reactions. this is particularly concerning for children and immunocompromised individuals (Eurofins Scientific, 2025).

Toxic effects: Some residues can damage vital organs such as the liver, kidneys, and cardiovascular system if consumed over extended periods.

Hormonal Imbalance: Certain veterinary drugs, especially hormonal growth promoters, can disrupt the endocrine system in humans. Chronic exposure to these residues may lead to hormonal imbalances, reproductive issues, and even increased risk of hormone-dependent cancers. This risk underscores why many countries have banned or strictly regulated the use of hormonal growth promoters in food-producing animals (World Health Organization, 2020).

HOW DO RESIDUES ENTER MILK AND MEAT

When dairy animals are treated with veterinary drugs such as antibiotics, antiparasitic, or anti-inflammatory agents, these substances circulate in the bloodstream. Since milk is synthesized from blood components, residues of these drugs can pass into the mammary gland and be secreted in milk. If withdrawal periods are not respected, the drug concentration in the blood remains high enough for residues to appear in milk. Because milk is a nutrient-rich biological fluid, it can easily absorb and carry chemical contaminants, including veterinary antibiotics (World Health Organization, 2020).

In meat-producing animals, drugs administered orally, by injection, or topically are absorbed into the bloodstream and distributed throughout body tissues. These drugs or their metabolites can accumulate in muscle, fat, liver, and kidney tissues. If animals are slaughtered before the drug has been fully metabolized and eliminated, residues remain in edible tissues. This is why withdrawal periods are critical: they allow time for the drug to degrade or be excreted before the animal enters the food chain (Food and Agriculture Organization, 2018).

WHAT IS WITHDRAWAL PERIOD

The withdrawal period is the minimum time that must elapse between the last

administration of a veterinary drug to food-producing animals and the collection of products such as milk or meat intended for human consumption. This period ensures that the drug is metabolized and eliminated from the animal's system so that residues in edible tissues or milk fall below the established *maximum residue limits (MRLs)*. In dairy animals, drugs administered systemically can pass into the bloodstream and be secreted into milk; therefore, withdrawal periods for milk are critical to prevent contamination. In meat-producing animals, drugs or their metabolites can accumulate in muscle, fat, liver, and kidney tissues, and slaughtering before the withdrawal period ends can result in unsafe residues entering the food chain. Observing these intervals is essential to protect public health and maintain compliance with international food safety standards (Claerebout & Lanusse, 2025).

IMPACT OF DRUG RESIDUES ON DAIRY AND MEAT INDUSTRY

Rejection of Export Consignments

Drug residues in milk and meat can lead to rejection of export consignments in international markets. Countries with strict food safety regulations routinely test imported products, and consignments exceeding maximum residue limits (MRLs) are denied entry. This not only damages the reputation of the exporting nation but also disrupts trade relationships. For example, studies in India have shown that antibiotic residues in milk samples exceeded permissible thresholds, raising concerns about compliance with international trade standards (Rising Concerns Over Antibiotic Residues, 2025).

Economic Loss to Farmers and Country

The presence of residues results in significant economic losses. Farmers face reduced income when their products are rejected or downgraded, while countries lose valuable foreign exchange earnings from blocked exports. Additionally, industries must invest heavily in testing, monitoring, and corrective measures to meet international standards, further increasing costs. In India, where milk production contributes substantially to the economy, lapses in residue control have been linked to financial setbacks for both farmers and the national dairy sector.

Loss of Consumer Trust

Consumers are increasingly aware of food safety issues, and reports of drug residues erode public confidence in dairy and meat products. Loss of trust can lead to reduced domestic consumption, affecting market demand and profitability. In India, widespread detection of antibiotic residues in marketed milk has sparked public concern, leading to calls for stricter regulation and safer practices (Rising Concerns Over Antibiotic Residues, 2025). Once consumer trust is compromised, rebuilding it requires long-term transparency and adherence to safety standards.

FACTORS CONTRIBUTING TO RESIDUE CONTAMINATION

Residues in milk and meat occur primarily due to gaps in farming practices and regulatory compliance. A key reason is the lack of awareness among farmers about the importance of withdrawal periods the time required for drugs to clear from an animal's system before its products are consumed. Without proper training, many farmers unintentionally allow contaminated milk or meat to enter the food chain. Additionally, ignoring withdrawal periods is common, as discarding milk during this time is seen as an economic loss, especially for small-scale producers who rely on daily sales. This pressure to maintain continuous production often outweighs safety considerations. Another major factor is self-medication without veterinary consultation, where farmers administer antibiotics or antiparasitic drugs without professional guidance. This leads to incorrect dosages and misuse of medicines, increasing the likelihood of residues. Poor record-keeping, repeated treatments, and off-label drug use further compound the problem. Combined with the economic pressure to maximize productivity, these practices create a cycle where food safety is compromised, resulting in risks to

public health and loss of consumer trust (Cornell University College of Veterinary Medicine, 2025).

REGULATION OF DRUG RESIDUES IN MILK AND MEAT

To protect consumers, regulatory authorities have established strict frameworks for monitoring and controlling drug residues in food of animal origin. In India, the Food Safety and Standards Authority of India (FSSAI) set *Maximum Residue Limits (MRLs)* for veterinary drugs in milk and meat. These limits specify the highest concentration of a drug residue legally permitted in food, ensuring that consumption remains safe (FSSAI, 2024). At the international level, the Codex Alimentarius Commission, jointly managed by the FAO and WHO, provides harmonized standards for MRLs. Codex guidelines are widely adopted in global trade, and countries exporting milk and meat must comply with these standards to access international markets (Codex Alimentarius Commission, 2019). Monitoring is carried out through random sampling and testing, particularly in the organized dairy and meat sectors. Export consignments are subject to even stricter regulation, as importing countries demand compliance with Codex and national standards. This means that milk and meat intended for export undergo rigorous residue testing, and consignments exceeding permissible limits are rejected, leading to economic losses and reputational damage for producers and the country (FAO, 2018).

CONSUMER ACTIONS TO PREVENT DRUG RESIDUES

Consumers can reduce their risk of exposure to drug residues by making careful choices about where they source their food. One of the most important steps is to buy milk and meat from trusted and regulated sources, since organized sectors are subject to routine testing and monitoring for residues. This ensures that products meet national and international safety standards (FDA, 2025). another effective measure is to prefer pasteurized and tested milk, as pasteurization is generally carried out in regulated facilities where milk is screened for contaminants, including drug residues. Similarly, consumers should avoid illegally slaughtered meat, which bypasses veterinary inspection and residue monitoring, thereby posing a higher risk of contamination (California Dairy Quality Assurance Program, 2013). Finally, consumers can support farms that follow Good Veterinary Practices (GVP), such as adherence to withdrawal periods, proper record-keeping, and responsible drug use. By choosing products from farms and cooperatives that prioritize food safety, consumers encourage safer farming practices and help reduce the prevalence of residues in the food chain (Shaikh & Patil, 2020).

CONCLUSION

Food safety truly begins at the farm, where responsible practices shape the quality of what reaches our tables. The careful and responsible use of veterinary medicines combined with strict adherence to withdrawal periods ensures that milk and meat remain safe for consumption. Farmers, regulators, and consumers all share a role in this chain of responsibility. Awareness today prevents health problems tomorrow by understanding the risks of drug residues, supporting farms that follow good veterinary practices, and choosing products from trusted sources, consumers can protect their families while encouraging safer farming. Ultimately, safeguarding food from residues is not just about compliance with regulations it is about protecting public health, sustaining trust, and ensuring that the foods we rely on every day remain wholesome and safe.

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