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Review "Poultry Meat Safety: Challenges and Advances in Veterinary Drug Residue Detection and Management

Asseel Abdulridha Saeed [1], Ishtar Adnan Mohammed Alethari [2]; Mahdi Abed Rabba AL-Shuwaili [3]

[1] Department of public health, [2] Department of Physiology, Pharmacology and Biochemistry, College of Veterinary Medicine, University of Al-Qadisiyah, Iraq
[3] Department of public health, College of Veterinary Medicine, University of Kuffa, Iraq

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Correspondence:
Alethari, Ishtar Adnan
ishtar.elethari@qu.edu.iq

Abstract The poultry industry around the world has grown quickly because more people want chicken that is cheap, healthy, and easy to prepare. One of the main concerns that have come up because of this growth is the high levels of chemical pollutants and veterinary drug residues in poultry meat. These chemicals can be very harmful to people's health if they are not properly administered or if the withdrawal periods are not followed. Hormones, antibiotics, and insecticides are some of the drugs used in animal farming that are often found in meat and egg. These residues can cause allergic reactions, antibiotic resistance, and even cancer in consumers. Numerous steps in the poultry production, such as feed quality, water supply, farm management, slaughter, and processing can result in contamination. Quick and reliable residue identification and measurement are now possible thanks to emerging technologies like chromatographic, immunoassays, biosensors, and hyperspectral imaging. However, maintaining constant surveillance continues to be difficult, particularly in developing nations where infrastructure and enforcement of regulations may be insufficient. Strict laws governing maximum residue limits (MRLs), thorough residue surveillance, and enhanced producer awareness are necessary for effective food safety management. Promoting safe handling and consumption practices also requires consumer education. Integrated strategies for residue reduction and risk mitigation be implemented successfully, cooperation between scientific communities, industry stakeholders, and policymakers is critical. Thus, ensuring the safety of poultry meat is critical to protecting consumer health and promoting company growth. Innovative residue detection methods, risk assessment frameworks, and sustainable farming methods should be given priority in subsequent studies to lower drug residues and contaminants in poultry products globally.

Keywords: Poultry meat, Drug residues, Food safety, Antibiotics, Contamination

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Introduction As families in India have made more money and learnt more about the health benefits of meat, they have been eating more poultry in recent years. The amount of chicken eaten by each person every year is at an all-time high of 2.4 kg, and the demand for chicken has been growing by about 10 to 15 percent each year. By the end of the century, it is expected to weigh five kilogrammes. India is the fourth largest egg producer in the world, making an average of 46 billion eggs every year. It is expected that the total number of eggs produced will rise to 390 million over the next two years. Every year, 6.05 million metric tonnes are made, and each person will eat 53 of them. [1]. As the production and consumption of poultry rise, making sure it is safe and of good quality becomes a major public health issue. Poultry is well-known for being cheap, healthy, and good for your immune system. The amount made around the world has gone up from 85 million to 120 million tons [2]. Due to the possibility of microbial contamination, which presents hazards at every stage of the supply chain, from farm to fork, the processing of chicken meat, including slaughter, handling, and preparation, is still extremely delicate [3]. Poultry products must adhere to hygienic standards in order to maintain public health safety and avoid foodborne illnesses. Regulations, such as those enforced by the European Union, have restricted the use of certain feed additives and antibiotics (such as chloramphenicol) due to their harmful and cancer-causing effects, which include allergic reactions and aplastic anemia. [4] The poultry farming system also uses human interventions, including medication, for managing illnesses and stress in laying flocks, spent hens, and day-old chicks. However, prolonged contamination in meat and eggs due to inadequate veterinary medication withdrawal periods raises concerns about antimicrobial resistance as well as potential consumer health risks [5]. To guarantee the safety of poultry products and to reduce the risks to the public's health created by drug residues, enhanced biosecurity measures, along with advanced monitoring and adherence to withdrawal periods, are crucial.

2. Types of Human Waste

Human residues in the food chain can indicate environmental chemical exposure. Various routes can carry residues from parent, biotic, and degradation products of metals and pesticides used in daily life to poultry food supply, although the feed chain is the predominant route. Human traces were identified in Jaipur poultry meat, raising health concerns [6]. In the next section, human residue exploration methods are reviewed. The study finds egg, muscle, and liver methods for determining organochlorine pollutants. This review has many references on OCP determination from chicken flesh, which may tilt toward meat determination. The pellet is methodologically separated into sample preparation, extraction, cleanup, and determination. Individual equipment and agencies employed for the analysis can provide instrumentation, clean-up consumables, and health and safety precautions for OCP recovery from meat. The sample preparation, extraction, clean up, and determination of organophosphate pesticide residue from chicken meat used SPME GC MS techniques [7]. CLERP sample preparation, extraction, clean-up, and determination are covered in several references. Chicken flesh ergocalciferol, ascorbic acid, iron, and sulfamethoxazole methods were not detected. The study provides literature references for micromethods of ergocalciferol estimation from various foods and iron and sulfamethoxazole estimation from beef. For chicken meat methomyl and perfluorinated alkyl carboxylic acid measurement, further sample preparation items were included. Chicken meat chlorobenzilate, oxadiazole, benzimidazole/benzamidazole, and dicarboximide pesticide determination methods are unproven. Exploring heavy metals includes assessing health risks from broiler chicken intake and preparing chicken meat samples in hot water at 70 °C for 15 min [8]. This study gives future food chain contamination exposure researchers a fundamental idea for analyzing organochlorine and organophosphate pesticides, human-induced chemicals, heavy metals, zootechnics, and antibiotics in poultry meat samples.

2.1 Chemical Byproducts

Organochlorine (OC) environmental contaminants are used globally in production and analysis. These compounds may harm ecosystems if living organisms accumulate them. Poultry production uses posterior pituitary hormones hormone mimetic (POHs) such as estrogens, phytoestrogens, and other substances lacking chemical similarity to hormones. This shows the importance of environmental cleanliness and OC and POH chemical residues in chicken samples from private and large—often small broiler farms. Chicken residue determination for POHs addressed contamination and bioavailability of chick tissues

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post-drinking water impregnation quickly. OCP investigation showed that chicken hens exposed to OC antibiotics and POHs lost bioactive residues after withdrawal time [9]. The present LLE-GC extraction approach works well with complicated tissue matrices that require substantial extraction. Results are close to optimal ranged-cum-tolerable MRPLs for pre-retail residues. Additionally, cleaning-extraction should ensure >99.994% residue recovery and reduce MRP-sampled-volume. Legislation is needed to set bioaccretable residue and composition withdrawal times. Results show that this applies to major Egyptian imports and private farm methods. MeMP would eliminate to-store-harm-free items and amications-validity-across-imported-kinds and sectors, highlighting the need for education and regulating chamber. Finally, a rapid approach for chemical residues in food would reduce potential hazards and increase regulation. Ma-based blister packs may sterilize indifferent solvents and contain dunciramines for worker-contact safety. The approach used LLE-purified product-matrix exchange with gaseous pre-cursed CRC before empty-matrix encapsulation dilution. X-ray diffraction-related foodicity profiles and bioaccretable chemical-safety content are lacking in exas in safe continuous-fc tolerated OW-CE separation conditions [10, 11].

2.2 Bio remains

Many families worldwide rely on chicken as a major protein source because it is inexpensive and nutrient-dense. Chicken is often preferred over beef, lamb, and pork due to its low cholesterol content, ease and convenience of preparation, and palatable taste [12,13]. Poultry farming commonly employs pharmaceuticals for growth promotion, disease prevention, and treatment of illnesses. Antibiotics are the most widely used veterinary drugs because of their low cost and easy accessibility. However, preventive antibiotic additions to poultry feed can cause pathological changes and reduce broiler chicken meat quality. Increasing evidence suggests that antibiotics used as growth promoters leave residual traces in animal tissues and derived products. Consumption of antibiotic-contaminated chicken meat is a potential health hazard for consumers. These residues can trigger allergic reactions, induce bone marrow abnormalities, alter gut microbiota composition, and cause toxic effects. Furthermore, human obesity and metabolic disorders are associated with changes in gut microbiota. Antibiotic residues consumed during pregnancy can increase the risk of autism in children as well as congenital malformations. Because of their broad-spectrum antibacterial activity and low cost, oxytetracycline and other widely employed tetracycline antibiotics are well-liked in veterinary medicine. Bacterial DNA gyrase is inhibited by quinolone antibiotics, such as ciprofloxacin. They have antibacterial properties and therefore stop DNA cleavage while stabilizing the enzyme-DNA complex. Consumer safety depends on the identification and measurement of antibiotic residues in foods and animal feed. Biosensor-based, immunological, enzymatic, microbiological, and mass spectrometric techniques are among the current methods for residue detection; chromatographic techniques, particularly high-performance liquid chromatography (HPLC), are thought to be the most accurate [14,15].

2.3 Physical Waste

With an increasing requirement for processed and ready-to-eat poultry products, rapid urbanization has an impact on meat consumption patterns, according to a study conducted in Hisar, Haryana, India, that investigated at the physico-chemical, sensory, and microbiological quality of raw chicken flesh. About 4 million metric tons of poultry are produced in India each year, with broiler meat accounting for 80% of this total. Elevated bacterial loads in poultry carcasses used on a daily basis in meat processing facilities are a result of large integrators in India. The Food Safety and Standards Regulations of 2011 clarify that poultry meat must be free of adulterants and infectious diseases. Many Scheduled Caste and Scheduled Tribe (SC/ST) communities in rural areas cook, boil, and dry their meat, while others hunt or use animal byproducts as food. The majority of rural vendors increase the risk of infection by not using proper post-slaughter preservation techniques. In order to produce meat according to acceptable quality standards, respondents mostly employed conventional methods for sourcing, preserving, and cooking poultry. Meat samples that were tested showed no signs of chemical or parasitic residues. Because of their attractive color, firmness, juiciness, and flavor, fresh meat samples were chosen. The measured concentrations of heavy metal pollutants varied between the 26.50 and 82.00 µg/g. Juiciness, texture, color, and appearance all had a strong correlation with sensory acceptability. Lactic acid

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bacteria dominated the eight predominant species involved in microbial spoiling. To guarantee safety in India's developing poultry industry, intervention studies are required to examine risk points throughout every step of the production and processing chain [16,17].

3. Broiler Chicken Human Residue Sources

There are many ways that people can get chicken broilers sick. Pesticides in feed, feed stores, and the soil around them can easily get into grill chicks. Also, spraying pesticides near chicken farms, generic stores, and using fumigation methods can all leave behind human waste in the grill area. Pyrethroids, bird-repellent pyrethroids, and organophosphate pesticides are all very harmful pollutants. If they are not used properly, they can make poultry meat and eggs unsafe for people to eat [18,19]. Vitamins and amino acids are examples of feed additives that are used as nutritional supplements. Growth boosters and antibiotics speed up weight gain and make feed more effective. Coccidiostats work to stop coccidiosis by targeting intestinal protozoa. Histomones are used to get rid of worms, but their main use is to stop infections, not to get rid of residues. People, animals, and the environment all have bacteria that form colonies. These bacteria often spread to chicken houses and hatcheries. The main health concern is the presence of harmful germs that people could get from eating contaminated poultry meat. This is why foodborne illnesses are such a big public health problem. Families in India have been eating more and more poultry in recent years because their incomes have gone up and they know more about how meat is good for their health. The demand for chicken has been going up by about 10 to 15 percent a year, and each person eats 2.4 kg of chicken a year, which is the most ever. It is expected that the weight will be five kilogrammes by the end of the century. India is the fourth biggest egg producer in the world. It makes an average of 46 billion eggs a year. It is expected that 390 million eggs will be made in the next two years. Out of the 6.05 million metric tonnes made each year, each person will eat 53 of them on their own. [1]. [1]. As more people eat and produce poultry, making sure it is safe and of good quality becomes a very important public health issue. People know that chicken is cheap, healthy, and good for your immune system. Global production has gone up from 1985 to 120 million tonnes [2}].

3.1 Feed Pollution

The chicken feed manufacturing industry has rapidly expanded to meet growing domestic poultry demands. Over the past five years, feed production growth has been accelerated by competition among local farmers. Due to insufficient industrial sewage control, feed mills in the lower Yangtze River basin are heavily polluted, which disproportionately affects broiler meat producers over layer farms. Numerous biochemical additives, such as starch sugars, organic fertilizers, citric acid broths, and amino acid fermentation broths, are added to feeds to increase growth rates and palatability, but they frequently lack adequate safety testing . Animal hormones, organophosphorus insecticides, antibiotics, aflatoxins, and pig DNA may pollute the meat of broiler chickens due to the poor manufacturing and conditions of storage of many feed ingredients. Food safety issues arise when pig and cattle secretions and organs are occasionally improperly added to feed additives. On broiler carcasses and transport vehicles, probiotic strains, starter cultures, and fermenting bacteria are sprayed at random, contaminating meat and feathers with dried residues. The residues of organochlorine pesticides and animal hormones in fresh and processed broiler meat were assessed in this study, which also developed two HPLC techniques for the simultaneous quantification of those chemicals in feeds [20, 21].

3.2 Supply Water Pollution

One of the significant problems facing poultry production globally is microbial contamination. In drinking water systems in broiler houses, biofilms lead to increased bacterial loads and promote the spread of zoonotic pathogens that can contaminate processed poultry products and carcasses. Few studies have evaluated the prevalence and characteristics of biofilm-forming bacteria in broiler farms, especially those in teleost farming regions, despite the fact that chemical disinfectants can decrease biofilms [22]. In recent decades, Thailand's broiler industry has expanded significantly, mostly for domestic consumption. Chemicals, viruses, and microorganisms can contaminate poultry. Poultry may suffer physiological harm from the overuse or inappropriate breakdown of antibiotics in water sources. One important way that pathogens are introduced by means of drinking water. Contaminants including pharmaceutical residues, antibiotic

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residues, heavy metals, and hormones have been detected in private wells, reservoirs, and municipal water supplies [23].

4.3 Environmental Factors

There are many issues facing the poultry industry that are influenced by human behavior and culture. Human-related pollution residues in poultry meat and the farmers who produce it were assessed in a recent study. Aflatoxin B1 (AFB1) contamination decreased by about 12.9% between the stages of production and harvest, but there are still significant worries about the remaining levels. Issues with drinking, smoking, poor hygiene, and a lack of work ethics were discovered through additional inputs and farmer interviews. The promise of quick profits has drawn many young entrepreneurs from rural areas to poultry farming; however, this rapid expansion frequently ignores important residue management and hygiene procedures. There are significant issues with residue contamination in the Indian poultry sector, which includes both small rural farms along with big industrial producers [24].

5. Methods of Detection

The first step in finding human contamination in grilled chicken meat is to do a systematic random sample. This method randomly selects sample units from a production batch. For instance, after choosing a random unit from the first 20 samples, every 20th unit is chosen for analysis. Semi-structured interviews with chicken companies' brand managers, buying technicians, and marketing managers help us understand the machines and methods used in production and processing. We can use this qualitative data to make initial assessment forms for checking meat or carcass processing equipment. Reviews of the literature help find the best ways to find human remains in grilled meat and other foods. Using statistics to make sense of survey results is common. This includes looking at numbers by age group, frequency, and percentage [25].

5.1 Lab Techniques

the Department of Veterinary Public Health and Epidemiology at the College of Veterinary Science and Animal Husbandry, Anand National Agricultural University, adopted laboratory techniques to identify human residues in broiler chicken. Using sterile stainless steel knives, 18 chilled broiler samples (skin, legs, and wings) were collected aseptically and then frozen at -20°C until analysis. Strict aseptic procedures were used during sample collection and processing to avoid contamination. To maintain sample integrity before laboratory analysis, sample packaging was sealed as soon as it was collected [26].

5. Field Testing Methods for Drug Residues in Poultry Meat

To assure food safety and safeguard the public's health, it is essential to find veterinary medication residues in poultry meat, figure (1). During poultry production, field testing techniques offer quick, affordable, and on-site screening tools to assist with timely decision-making. Immunoassays such as lateral flow immunoassays (LFIAs), biosensors, and enzyme-linked immunosorbent assays (ELISA) are examples of common field techniques. The high sensitivity and specificity of these techniques enable the detection of antibiotic and hormone residues, which involve tetracyclines, sulfonamides, and β-lactams [27,13]. ELISA kits are frequently used for thorough screening in farms and slaughterhouses due to their simplicity of use and speed of turnaround. Due to their simple of use and little equipment requirements, lateral flow devices are perfect for field use without demanding laboratory infrastructure [14].. Multiple residues can now be detected simultaneously thanks to improvements in biosensor technology that have increased sensitivity and multiplexing capability. despite their benefits, field tests necessitate confirmatory laboratory analysis to handle false positives or matrix interferences, typically using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Global regulatory compliance and the safety of poultry products depend on constant improvement and validation of portable, efficient testing techniques [28].

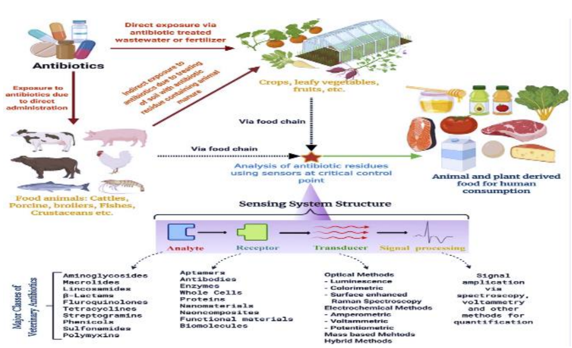

Figure (1): Sources of antibiotic residues in foods and their detection using sensors at critical control points within a food chain

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6. Human Residue and Poultry Safety

Uncontrolled human residue contamination in poultry meat presents a significant public health risk. A pilot study in South Australia, a coastal state with over 1 million inhabitants, employed innovative technology to detect human residues in retail broiler chicken meat samples. All tested samples were positive for human residues using the methodology developed. The pilot effort advances the testing and validation of food products to identify biological human material that may have been transferred by several handlers. Because broiler chicken meat is so widely consumed, finding human residues is essential information for food safety monitoring. Human residues were successfully eliminated from chicken samples using an approach consisting of bead grinding and temperature-controlled washing [29].

6.1 Consumer Health Risks

Poultry meat is an essential source of protein, fats, and minerals like iron and zinc at an affordable price compared to other meats. In 2018, global poultry meat production reached 127 million tons, with per capita consumption averaging (13.89 kg). The cultivated broiler chicken (Gallus domesticus) constitutes about 53% of the world's total meat production. People from all socioeconomic backgrounds prefer poultry meat due to its affordable price and nutritional benefits. There may be a chance of residue contamination at every point in the supply chain. While consumers who care about the environment favor safe and nourishing options, wealthier consumers are advocating for healthier, higher-quality poultry products. Poultry consumption has surged in many developing nations, requiring strict control of health hazards. Because poultry is frequently consumed raw or very lightly cooked, contamination control is even more crucial than it is for other meats. Human health is at risk from contamination in the poultry manufacturing chain, which includes hatcheries, farms, feed mills, slaughterhouses, transportation, retail, and food preparation.. Antimicrobial resistance may result from the unlawful use of human, veterinary, or environmental chemicals to treat poultry meat. Inadequate personal hygiene practices allow hazardous intestinal bacteria to survive and proliferate. Cooking and marketing techniques are two important ways that infections are spread. [30]

6.2 Poultry Industry Impact

The poultry industry is a major global food source but faces challenges due to food safety concerns. Rapid development of broiler chickens allows for efficient and lucrative production, but it also raises moral questions regarding animal welfare. The welfare concerns at farms and slaughterhouses are now more widely understood to consumers. Edible animal byproducts are usually discarded for reasons of sanitation, despite the possibility of residues remaining. The cooked poultry skins may contain spices and herbs, but they may also contain impurities that decrease the quality of the food. Identifying halal meat, confirming the provenance of raw birds, and spotting contamination when handling carcasses are some of the problems. Because of contaminated raw materials and inappropriate handling, the increasing use of poultry byproducts in processed foods (chips, sauces, and gravies) raises questions regarding their safety and quality.. Food safety and consumer confidence depend on these issues being resolved. Even though previous studies have identified plenty of risks and detection methods, problems with the quality of human food remain unresolved. Customers expect safe and quality-controlled production of poultry products. Customers anticipate that poultry products will be processed safely and with quality control. Present investigation focuses on the hazards and remedies associated with food byproducts derived from poultry. [30,31].

7. Regulatory Standards and Guidelines

Biological contaminants and antibiotic residues in poultry pose serious global food safety issues. A significant amount of the country's animal protein comes from the thriving and well-organized Indian poultry industry. Product safety and quality are still issues in spite of this. Several phases of production, including distribution and processing, are contaminated. Medically significant human antibiotic residues have been found in poultry meat as a result of antibiotic misuse, particularly in Hyderabad. Such abuse puts consumer health at risk by accelerating the development of pathogenic microbial resistance. Monitoring antibiotic residues is critical for public health protection, table (1) [21,32].

Table 1: Maximum Residue Limits (MRLs) and Withdrawal Periods for Common Veterinary Drugs in Poultry Meat

Veterinary Drug	MRL in Poultry Meat	Withdrawal Period	Reference Source

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Oxytetracycline	200 µg/kg (Codex)	7 days	Codex Alimentarius (2019)
Enrofloxacin	100 µg/kg (EU)	5-7 days	European Medicines Agency (EMA) (2022)
Chloramphenicol	Banned (0 µg/kg)	N/A	Codex Alimentarius, WHO (2011)
Sulfonamides	100 µg/kg (Codex)	5-7 days	Codex Alimentarius (2019)
Tylosin	100 µg/kg (EU)	7 days	EMA (2022)
Amoxicillin	50 µg/kg (EU)	3-7 days	EMA (2022)
Gentamicin	100 µg/kg (Codex)	7 days	Codex Alimentarius (2019)
Doxycycline	100 µg/kg (Codex)	7 days	Codex Alimentarius (2019)
Nitrofurans	Banned (0 µg/kg)	N/A	Codex Alimentarius, WHO (2011)
Neomycin	200 µg/kg (Codex)	7 days	Codex Alimentarius (2019)
Florfenicol	200 µg/kg (EU)	5 days	EMA (2022)

7.1 International Standards

Meat safety is governed by national and international laws, but enforcement varies, particularly in nations that are developing where supply chains present hazards to food safety. To create and implement regulatory frameworks, government agencies work with scientific communities. Risk assessments and hazard identification are crucial for confirming the safety of meat production. Trace-back investigations aid in locating risk factors and sources of contamination. During outbreaks, temporary safety precautions and consumer and retailer communication are required. Farm-to-fork examination constructs frameworks for risk assessment and directs interventions. The production and consumption of meat have increased quickly in many emerging economies. To continue being competitive in exports , governments, industry stakeholders, and academia must improve food safety and hygiene, logistics, animal welfare, and environmental sustainability. Recommendations from advanced countries provide practical guidance [23,24].

7.2 Nationwide Rules

Poultry is a valued food worldwide. Increased production heightens food safety concerns, particularly pathogen contamination. To prevent residues and pollutants in poultry production from hatcheries to slaughterhouses, developed nations have put strict controls in place. Inconsistent agricultural practices are an issue for developing nations. Laws governing veterinary drugs, residue monitoring, and enforcement differ greatly. Products from North America and Europe are examined for stringent safety testing for chemical contaminants such as pesticides, heavy metals, antibiotics, and mycotoxins. Carcasses that test positive for salmonella are either decontaminated or destroyed. Gel tests guarantee that poultry products that violate maximum residue limits (MRLs) are taken off the market. Systematic sampling and compliance testing are necessary in developed nations. It is illegal for non-compliant producers to export. [33,26].

9. Consumer Education and Awareness

Food safety and consumer health concerns have grown with increasing meat consumption. Meat and meat products are vital dietary components. However, contamination with veterinary drug residues poses health risks including hypertension, cancer, and economic impacts. Antibiotic residues and resistant bacteria are major problems in poultry meat. Antibiotics used intensively in broiler farms promote resistance, which can spread through the food chain [34]. Human residues in poultry include antibiotics, anti-inflammatory, anti-epileptic drugs, and steroids. Some drugs are authorized for growth promotion and prophylaxis, but banned substances are still used due to

10. New Technologies

In order to meet demand and minimize antimicrobial resistance, the broiler industry attempts to use antibiotics as little as practicable. The US permits the use of antibiotics to control salmonella, while the European Union and Denmark prohibit their use for growth promotion. Consumer perceptions are impacted by these policies. Rapid, noninvasive detection of antibiotic residues is made possible by nondestructive detection techniques such as dual-polarization imaging (DPI) and hyperspectral imaging. Hyperspectral imaging can detect the absorption of antibiotics in near-visible/near-infrared light (560-

1000 nm). Calibrated using wheat grain models, the systems cost about $305 [35, 36]. Five to ten carcasses of poultry can be detected for antibiotic residues per minute using DPI technology. Before processing, whole carcasses could be screened using hyperspectral imaging, that's could produce a yes/no residue result.hybrids.DPI-hyperspectral hybrids are potential commercial tools. DPI can be used pre-processing to reduce residue spread; labs may employ hyperspectral imaging for product safety assessment and system design improvements.

11. Conclusion

People are becoming more aware of the health benefits of poultry meat, and prices are going up, which is making demand for it around the world. Because of this, drug residues and contamination of people have become problems. Hormone mimetics and antibiotics that are left over from taking care of animals can lead to cancer, allergic reactions, and antibiotic resistance. There needs to be constant monitoring of every part of the complicated chicken supply chain, from the contamination of feed and water to processing and slaughter. Chromatography and immunoassay are both quick and accurate ways to look for residues, but they are hard to use all the time, especially in developing countries where rules aren't always followed. This study says that to keep people healthy, there need to be strict rules, like testing for residues, withdrawal periods, and limits on residues. Biosensors and hyperspectral imaging are two examples of cutting-edge technology that can help find things on-site. But they need to be tested more and cost less before they can be used a lot. It is very important for chicken producers to teach and train people how to avoid getting sick. Scientists, businesses, and government officials need to work together to make food safer and easier to keep an eye on. Factories need to be cleaner, they need to keep an eye on leftovers, and public health programs need to be better to keep poultry meat safe. To keep customers safe and help the chicken industry grow, we need to do research to find, test, and fix problems with residues.

Conflict of interest

There is no conflict of interest in this study as stated by the authors.

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