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EDITORIAL;

ROLE OF STEROID GROWTH PROMOTER ON GROWTH PERFORMANCE AND MEAT QUALITY TRAITS IN BROILER

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Introduction

Chicken is a preferred choice among nutritionists and health professionals due to its exceptionally low fat content. Compared to red meat, chicken boasts significantly lower fat levels:

- Chicken: less than 3g of fat per 100g serving
- Red meat: 5-7g of fat per 100g serving

This striking difference makes chicken an attractive option for those seeking a leaner protein source. As a result, poultry industry is expanding rapidly, playing a pivotal role to meet the protein needs through supply of affordable nutritious eggs and meat, especially in today's world's with fast growing population. Poultry products offer high-quality proteins, essential amino acids, vitamins, and minerals, while being relatively low in cholesterol. However, growing industrialization and resultant greenhouse gases impact on environment perpetuated pollution, thereby increase the risk of poultry feed contamination with toxic substances during processing. Poultry feed can be affected by chemical, biological, or physical hazards, resulting from handling, during storage and, transportation, or intentional/ accidental contamination.

Ensuring food safety is crucial to prevent adverse effects in humans and animals, as poultry products can potentially harbor infectious agents, antimicrobial residues, and pesticides, thus posing significant health risks and my include but not limited to:

- Causing rising Antimicrobial-resistance (AMR), resulting from ingesting antimicrobial treated poultry.
- Campylobacter and Salmonella infections becoming prominent food safety concerns.
- Heavy metal contamination (lead, cadmium, mercury, chromium, iron, copper, and zinc) in poultry increasingly threatens public health.

Bangladesh Study

A study in Bangladesh analyzed 108 broiler chicken samples from Dhaka North City Corporation markets for toxic heavy metals and trace elements using Atomic Absorption

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Spectrometry (AAS). The purpose of the study was to evaluate the quality of chickens consumed and the risks to the public's health.

They measured and examined the levels of trace elements and heavy metals in broiler chickens. According to the findings, the concentrations varied from:

0.33 ± 0.2 to 4.6 ± 0.4 milligrams per kilogram (mg/kg) of fresh weight for Lead (Pb),
0.004 ± 0.0 to 0.125 ± 0.2 mg/kg for Cadmium (Cd),
0.006 ± 0.0 to 0.94 ± 0.4 mg/kg for Chromium (Cr),
4.05 ± 4.2 to 92.31 ± 48.8 mg/kg for Iron (Fe),
0.67 ± 0.006 to 4.15 ± 2.7 mg/kg for Copper (Cu), and
4.45 ± 0.62 to 23.75 ± 4.3 mg/kg for Zinc (Zn).

Metals

Notably, the majority of the heavy metals and trace elements that were examined in chickens had levels below the maximum allowable concentration (MAC) established by the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), and other regulatory bodies. Lead (Pb) and copper (Cu) levels, however, were found to be higher than advised.

Moreover, the estimated level of Lead (Pb) was nearly six times higher in the chicken brain, indicating potential neurotoxic effects.

THQ (I)

In another study a target hazard quotient (THQ) analysis was conducted in USA to assess the health risks associated with consuming broiler chicken meat. The THQ values varied for adults and children and were found to range from:

0.037 to 0.073 for Lead (Pb),
0.007 to 0.01 for Cadmium (Cd),
0.0 to 0.08 for Chromium (Cr),
0.002 to 0.004 for Iron (Fe),
0.00 to 0.002 for Copper (Cu), and
0.004 to 0.008 for Zinc (Zn).

These values did not exceed the maximum level of 1, as recommended by the United States Environmental Protection Agency (USEPA).

THQ (II)

In addition, the total target hazard quotient (TTHQ) and calculated THQ values were less than one, indicating that eating chicken meat does not give a substantial risk of cancer to consumers.

Moreover, the target carcinogenic risks (TCRs) of Lead (Pb), Cadmium (Cd), Chromium (Cr), and Copper (Cu) were also found to be within acceptable limits.

However, the study highlights that consumers are chronically exposed to elemental contamination through broiler chicken meat, which potentially carry both carcinogenic and non-carcinogenic health effects.

Overall, the findings of this study emphasize the importance of monitoring heavy metal levels in poultry and enforcing stricter regulations on feeding and farming practices to minimize potential health risks to consumers.

TYPES OF RISKS

A. RISK TO CONSUMERS

Urbanization; The shift from rural to urban living has significantly altered eating habits, driving the need for development of newer food production, preparation, and distribution methods. This transformation has led to a introduction and expansion of "fast food" and

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ready-to-eat options, reducing consumers' control over meat selection, preparation, and storage.

Vulnerable populations, such as children and individuals facing malnutrition, are particularly susceptible to food-borne bacterial diseases under all circumstances but more so during conflict or natural disasters. The primary symptom of these illnesses is diarrhea, which can be fatal (with a 0.01% mortality rate among infected individuals in high-income countries).
Fortunately, since bacterial infections cause these diseases, antibiotic treatment is effective, which increases the risk of overuse and growing anti-microbial resistance among the populations especially in the developing countries.

Potential Risks to Human Health Through Chicken Feed

There are a number of contaminants and practices in chicken farming that pose potential health risks to humans and include:

a. Chemical Contaminants

1. Use of pesticides in crops and Toxic plants
2. Dioxins, melamine, and dibenzofurans
3. Heavy metals contamination such as Lead, Mercury, Arsenic, Antimony, etc. through industrial waste, water and crops
4. Radionuclide contamination
5. Use of Byproducts of biofuels in animal feed

b. Biological Contaminants

1. Microbes and mycotoxins
2. Endoparasites

c. Genetic and Technological Concerns

1. Genetically modified crops for commercial feed, enzymes, and organisms used for production of commercial feed
2. Nanotechnology byproducts in feed

d. Other Risks

1. Therapeutic technique and sub-therapeutic antibiotics used in preparation of poultry feed
2. Poultry feed as a target for bioterrorism

These potential risks highlight the importance of regulating and monitoring chicken feed production to ensure consumer safety.

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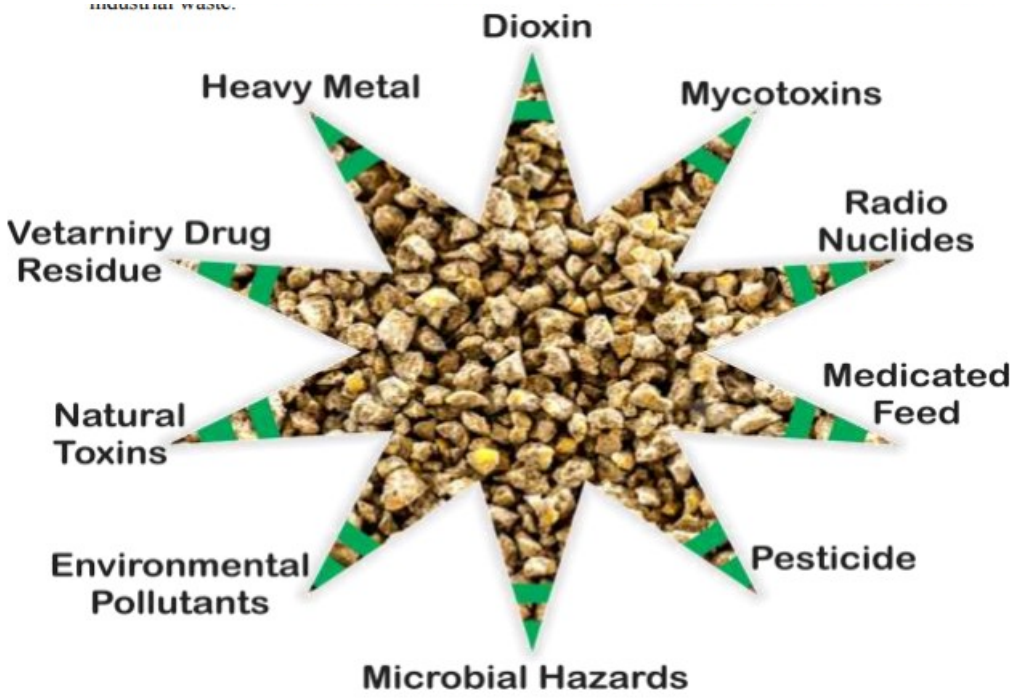

B. Side Effects

Effect of pesticides on human health through poultry feed

The widespread application of pesticides in agriculture has led to the persistence of pesticide residues in food crops, which subsequently contaminate poultry feed. This contamination has severe implications for human health, as pesticide residues have been detected in:

1. Chicken meat
2. Farm eggs

Multiple studies have specifically identified the presence of:

1. Organochlorine pesticide residues (OCPs)
2. Hexachlorocyclohexane isomers (HCHs)
3. Dichlorodiphenyltrichloroethane and metabolites (DDTs)

Human Health Risks Associated with Pesticide Residues

Consuming poultry meat and eggs contaminated with pesticide residues poses significant health risks, including:

1. Damage to the nervous system, leading to neurological disorders/ cognitive impairment and motor dysfunction.
2. Reproductive issues, such as birth defects and fertility problems (infertility and sterility)
3. Increased risk of cancer development
4. Fetal death and developmental abnormalities (Birth defects and growth retardation)

Poultry feed; Effects of dioxins and dioxin-like substances

Dioxin and dioxin-like compounds (DLCs) are pervasive environmental pollutants that contaminate animal feed, thus posing health risks to humans. Sources of dioxin contamination in poultry feed include:

1. Polluted fuels used to dry feed (e.g., poor-quality coal, contaminated fuel oil, treated wood etc)
2. Contaminated products (e.g., clay minerals, lime in citrus pulp)
3. Industrial processes (e.g., incinerators)
4. Environmental deposition (air, water, soil, fertilizers, pesticides)

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Dioxin can accumulate in animal tissues used in poultry feed and be ingested by poultry animals through:

1. Soil contamination
2. Contaminated feed

Implications for human health

Exposure to dioxin has serious health consequences, including:

1. Cardiovascular problems
2. Cancer
3. Diabetes
4. Hormonal imbalances (thyroid, testosterone)
5. Immune system disorders
6. Skin and nail abnormalities
7. Reproductive issues (early menopause, delayed breast development, endometriosis)
8. Neurobehavioral problems (hearing, psychomotor, cognition, dentition)

Prenatal exposure to dioxin can lead to:

1. Altered neurobehavioral development
2. Increased thyroid-stimulating hormone in neonates

Studies have demonstrated the persistence of dioxin's harmful effects, even decades following initial exposure.

Antibiotic Resistance (Antimicrobial Stewardship)/ AMSS

Effects of antibiotics on human health in poultry feed

The widespread use of antibiotics in poultry feed has been a longstanding practice, yielding benefits such as improved growth rates and reduced disease susceptibility. However, concerns have emerged regarding the potential risks to human health due to the development of increasing Anti-Microbial Resistance (AMR) being fueled by injudicious use of antibiotics and development of antibiotic-resistant bacteria strains.

The exact mechanisms behind antibiotics' growth-promoting effects remain unclear, but theories include enhanced metabolism, nutrient absorption, and antimicrobial activity.

Antibiotic resistance has become a significant public health concern, with Salmonella being a primary culprit in transmitting resistant strains from animals to humans.

In response, regulatory agencies like the FDA have proposed restrictions on subtherapeutic antibiotic use in animal feed to mitigate human health risks.

Striking a balance between agricultural efficiency and public health needs requires careful consideration. Alternative growth promoters and responsible antibiotic use practices must be developed to ensure food safety.

Manifestation and complications among Humans

Skin Diseases

A case of Arsenic poisoning in a patient, diagnosed by Prof. K. C. Saha in 1984 at the School of Tropical Medicine, Calcutta. Changes in the skin can present as an erythematous flush, which may progress to conditions such as melanosis, hyperkeratosis, and desquamation. Patchy dermal pigmentation can appear similar to raindrops on a dusty road. Prolonged exposure has the potential to lead to basal cell and squamous cell carcinomas. According to Pershagen and Braman, a rare precancerous skin condition referred to as Bowen's disease is thought to be linked to arsenic and the human papilloma virus (HPV).

Multiple Diseases (Haematological/ Respiratory/ Hepatic/ Malignant); The presence of anemia, thrombocytopenia, megaloblastic anemia, and leucopenia is possible; toxicity results

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in decreases in lymphocytes, hemoglobin, packed cell volume, erythrocyte count, and total leukocyte count. A potential lung complication is asthmatic bronchitis. Furthermore, problems like ascites, splenomegaly, and hepatomegaly may be present in many cases. Cancers of the skin, lungs, bladder, and uterus can arise from long-term exposure to arsenic.

Lead (Pb)

Smelters, combustion engines, burning oil, industrial waste, lead pipes, and other sources can contaminate soil, air, and water. Lead from industrial waste can also contaminate water and soil. Additionally, plants used to make poultry feed have the ability to root themselves in the ground.

Lead-containing metallo-proteins are formed after absorption from the gastrointestinal tract and are subsequently distributed throughout the chicken.

The tainted meats and eggs pose a risk to public health and need to be closely watched. Exposure to lead in humans has harmful effects on both adults and children. Lead can pass through the blood-brain barrier and is readily distributed throughout the body. The active matrix of bone, which serves as the body's inert Pb reservoir, contains 90% of the lead.

The active matrix of bone, which serves as the body's inert Pb reservoir, contains 90% of the lead. It can lead to growth retardation, delayed puberty, neurobehavioral disorders, and poor cognitive function in kids. Reduced fetal growth may result from maternal toxicity. Adults may experience tremors, elevated risk of cataract development, degenerative disorders of the central nervous system, hypertension, and a decline in kidney function.

Mercury (Hg)

Feed ingredients, such as using crops and fish tainted with mercury, etc.

Human mercury poisoning can result in a number of health issues, including: Central nervous system effects, e.g. Numbness in the limbs. Ataxia, dysarthria, tremors, and visual field narrowing. harm to the facial cortex and cerebellum. Additionally, it may result in diarrhea, colitis, nausea, vomiting, and abdominal pain. Drooling, perioral paresthesia, and gum discoloration are additional symptoms. The organic mercury poisoning is well-known for producing teratogenic effects that resemble cerebral palsy. Mental retardation, seizures, tremors, chorea, cataracts, spasticity, disruption of hepatic enzymes, irritation of the respiratory tract, renal dysfunction, and cardiac arrhythmias are some of the possible consequences.

Cadmium (Cd)

The natural inorganic form of cadmium is produced by the deterioration of rocks. Cadmium levels in the environment have increased because of a number of industrial processes, including metal smelting, fuel burning, waste disposal in incinerators, fertilizers, and discarded cadmium chloride products.

The maximum allowable levels of Cd were found exceeded in the meat, liver, and eggs. Cadmium has similarities to many essential metals but no essential role in the human body. It is similar to iron, copper, and zinc. It has an impact on the absorption of copper and zinc because it is readily absorbed and distributed throughout the tissue. It can enter cells with ease, but leaving them is extremely challenging. The kidneys and liver accumulate cadmium. Its exposure results in endocrine abnormalities, cancer, teratogenesis, osteoporosis, CNS toxicity, and renal toxicity.

Fungal Infections

Adverse effects of Mycotoxin contamination found in poultry feed

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Since "mykin" means "fungus," "mycotoxin" refers to a toxin that is derived from fungi and is also referred to as bisfuranocoumarines. The teratogenic, carcinogenic, and mutagenic effects of these toxins are widely recognized.

It is well known that mycotoxin contamination of animal feed can cause death in animals and spread the toxins to people through the consumption of eggs, meat, or milk.

Long-term toxicity Asphyxia, laryngitis, vertigo, mucous membrane hyperemia, esophageal pain, and gastroenteritis are some of the symptoms. Hepatitis, jaundice, and eventually death are the consequences of aflatoxicosis. Hepatocellular carcinoma is caused by aflatoxin and HBV infection working together. Human cellular immunity is weakened by aflatoxins, which reduces resistance to infections.

Radioactive substance in poultry feed

Every living creature on the planet is constantly exposed to trace amounts of various radiations, which are referred to as natural background radiations. Radioactive materials are used in nuclear weapons, nuclear power plants, and medicine as a result of advancements in nuclear science technology. These radioactive materials release radiation that is toxic to living organisms. In addition to being exposed to these radiations, various food chain plants and animals are also the source of radioactive nuclide transmission to humans. Radiation exposure from soil, air, and groundwater can affect crops which are used to produce poultry feed. There are significant amounts of uranium, thorium, and radium in the rock phosphates used to make fertilizers. Radon, a byproduct of rotten uranium, is released by these fertilizers and contaminates soil.

The kidneys, bone marrow, reproductive system, spleen, and digestive tract can all be seriously impacted by a lethal dose of highly radioactive 210 Po (polonium), which can be as little as 1μg.

Dexamethasone (DEX)/ Steroid

In order to increase the overall feed efficiency and growth rate, growth promoters are added to broiler feed. In a recent study, that examined the effects of the widely used growth promoter dexamethasone (DEX) on the muscle biology, meat quality, and growth rate of broilers. For a period of 28 days, four uniform groups of 20 broiler chicks each were fed commercial broiler feed, with the treatment groups receiving 3, 5, and 7 mg/kg of DEX along with their food. Every day, body weight and feed intake were recorded. On days 7, 14, 21, and 28 of the experiment, muscle samples were taken in order to study the biology of the muscles and the quality of the meat. Thin-layer chromatography was used to find the DEX residue in meat. We found that DEX significantly reduced the broiler's feed intake, feed efficiency, and overall weight gain ($P < 0.05$). Chicks fed DEX showed a significant increase in relative meat weight (meat/body weight), despite a decrease in the weight of breast and thigh meat. In the DEX groups, body fat decreased at the same time that the percentage of fat increased significantly ($P < 0.05$). On the other hand, DEX enhanced the examined meat quality metrics, albeit at the possible risk of a high concentration of DEX residue (7 mg/kg) building up in the meat. Additionally, it was noticed that DEX considerably reduced the cross-sectional area of myofibers and increased their number. These results lead us to the conclusion that DEX decreases growth rate, feed efficiency, and feed intake, but it may enhance meat quality. However, if fed in excess, there may be a risk of residual DEX accumulation.

Proposed Solutions

Regulatory Implications and Mitigation Strategies

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In order to address the growing risks associated with pesticide residues in poultry feed and products, key steps needs to be taken to tackle the issue on priority basis, such as:

1. Regulatory agencies to establish and enforce stringent pesticide residue limits
2. Farmers should adopt integrated pest management practices to minimize pesticide use
3. Poultry feed producers to enforce ensure rigorous quality control measures
4. Consumers advocacy to prioritize use of organic and sustainably produced poultry products

The presence of pesticide residues in poultry feed and products poses significant health risks to consumers. It is essential to adopt a multi-pronged approach to mitigate these risks, encompassing regulatory action, agricultural best practices, and consumer awareness.

Heavy Metals (Arsenic)

Poultry feed having Heavy metal toxicity and its effects on human health, both organic and inorganic forms of arsenic are commonly found in the environment. A variety of arsenic complexes, such as natural phenol arsenic acids, are used as coccidiosis additives in poultry feed. The Food and Drug Administrations around the world need to set up standards and enforce regulatory measures including approval of globally accepted poultry additives, such as arsanilic acid (2-aminobenzenesonic acid or C6H8 AsNO3) for poultry feed and Roxarson organic arsenic (3-nitro-4-hydroxyphenylsonic acid, commercially known as 3-Nitro).

Recommendations

Over the past 20 years, the pattern of outbreaks of food-borne illnesses has evolved. The majority of outbreaks in the past were severe, localized, and caused by high levels of contamination. These days, a number of outbreaks that are caused by low-level contamination of commercial food products that are widely distributed impact multiple countries simultaneously. The Food-borne Disease Burden Epidemiology Reference Group (FERG), established by WHO, unifies global efforts to assess and lessen the significance of food-borne illnesses. This will assist nations in assessing the extent of foodborne illnesses and tracking advancements in their management. Food safety issues can be resolved with the help of an international network of labs, alert systems, and cooperation between authorities.

By keeping the meat in the refrigerator from the time it is purchased until it is ready to be consumed (heated), consumers can lower their risk of contracting bacterial food-borne illnesses. In order to reduce risk, cooking time and temperature are crucial. If the meat is properly cooked, contaminated portions are less likely to result in food poisoning. Certain bacterial toxins, on the other hand, are heat-stable and cannot be rendered inactive. From the time of slaughter until cooking, careful consideration must be given to reducing bacterial contamination and growth. If not prepared properly, coagulated blood, blood pudding, and chicken-and-duck blood soup can all contain dangerous pathogens. The Five Keys to Safer Food initiative has been developed by the World Health Organization (WHO). To reduce the prevalence of food-borne illnesses, messages have been created for consumers and food handlers. Tools for training and education have also been created. One crucial step in reducing the risks that poultry products pose to human health is education.

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