



Heavy Metals in Poultry Chicken and Human Health Threat: A Mini Review

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<p>Abstract: It has been shown that the most hazardous heavy metals that are constantly emitted into the environment are arsenic (As), lead (Pb), cadmium (Cd), and mercury (Hg). These metals can be found in both naturally occurring and artificially produced fertilizers, industrial processes, and waste disposal. Due to ongoing exposure to heavy metals, bioaccumulation of As, Pb, Cd, and Hg takes place in a variety of organs in chickens, primarily the kidneys, liver, reproductive organs, and lungs. Chemical, biological, or physical risks can be connected to animal feed. Poultry feed contamination can come from negligent or intentional handling, storage, and transportation practices. Because of the increased concentration of these heavy metals in these tissues—primarily the brain, liver, kidneys, and reproductive organs—chronic exposure to low doses of As, Pb, Cd, and Hg can alter the microscopic structure of these tissues. This puts human health at risk when consuming chicken or poultry. Risks to food safety should be carefully considered in order to reduce unfavorable side effects in both people and animals. Governments should therefore implement stringent measures to prevent any harmful contamination that could endanger public health. This review presents a discussion of bioaccumulation of As, Cd, Pb, and Hg in poultry with the associated problem of consumption of poultry and human health.</p> <p>Keywords: Poultry, Heavy metal, Chicken, Pesticide, Lead.</p>	<p style="text-align: center;">Review Paper</p>
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1. INTRODUCTION

One of the main risks to human health has been shown to be heavy metal toxicity [1]. The class of metalloids and metals having an atomic density of more than or equal to 4,000 kg/m³ comprises heavy metals [2]. Animals can take up metals and other environmental components from food, water, sediment, and the air [3, 4]. One of the biggest toxins in our food supply is heavy metal contamination, which poses a major risk to our ecology [5]. Worldwide, there is a high prevalence of heavy metal contamination, particularly in areas near cities and industrial zones [6]. The vital elements zinc (Zn), iron (Fe), copper (Cu), and selenium (Se) each have particular roles in controlling the metabolism of the organism [7]. On the other hand, dangerous metals including lead (Pb), chromium (Cr), mercury (Hg), nickel (Ni), and cadmium (Cd) are usually linked to contamination and can pose a threat to living things if certain quantities are exceeded [8, 9]. Some heavy metals, like Cd, Pb, As, Cr, Hg, and Ni, are present in trace amounts in water, fish, poultry, and birds [10]. The bulk of heavy metals detected in agricultural soil are mostly found due to the application of poultry and animal dung, which comes in second after air deposition [11-13]. Over the past ten years, several heavy metals (such

as Cd and Hg) have accumulated in cultivated areas as a result of specific uses of poultry and cattle manure [14-16]. Contamination of the diet with lead (Cd) comes from the environment and a range of food sources, which are then transferred to animals via the food chain, and it constitute to high metal consumption [17, 18].

Millions of people worldwide rely primarily on chicken as their source of protein, making poultry farming one of the most significant food-producing enterprises in the world [19, 20]. The feed given to broilers is the cause of health issues in humans. Grain seeds, soybeans, grass, biscuits, meat, blood, fish meal, fat, oil, decorticated cottonseed bran, corn gluten bran, guar bran, peanut cake minerals, subtherapeutic antibiotics, etc. are the primary ingredients of chicken feed. This diet might contain fungus, parasites, and soil poisons. The health of hens may be impacted by this contamination, which could eventually harm humans [21-23]. Global egg production reached 83 mega ton in 2019, up 63% from 2000, while chicken meat accounted for almost 40% of global meat output in 2019, underscoring its importance as the world's most produced meat [24]. In chicken feed, a variety of hazardous metals are present as trace amounts and are

added as feed additives [25]. Consumption of these poultry leads ultimately to the hazardous human health effects include loss of weight, headache, organ failure, cancer and death. This article's primary objective is to raise people's awareness of what they are consuming and provide information to identify the cause of excess heavy metal and its detrimental effects on health.

2. Lead on Poultry

In industrialized regions of the world, lead (Pb) is one of the most environmental toxins that animals are frequently exposed to [26]. Lead (Pb) is an element that is naturally found in the inner layer of the earth's crust. It can be found in numerous parts of the environment and is released into the air through the burning of gasoline, plant fuel, drinking water, recycled materials, dust, cosmetics, and lead-based paints [27, 28]. Animals that consume lead orally and only absorb very little of it; yet, following prolonged low-level exposure, a dangerous concentration of lead can build up in tissues because of the sluggish rate of lead elimination. Pb affects every living system, including poultry, when it comes into contact with food, drink, and the air [29, 30].

By producing free radicals, lead (Pb) can both induce oxidative stress and act as a catalyst for biological molecules' oxidative activities. The harmful effects of lead (Pb) might vary depending on the extent of exposure, ranging from mild physiological or biochemical abnormalities to serious pathologic disorders where different organs and systems may be damaged or their normal functions changed [31, 32]. Pb inhibits the functions of numerous antioxidant defenses; low antioxidant levels can harm the neurological system, liver, kidneys, and reproductive system, among other organ systems [33]. Deposited lead (Pb) in the organ of poultry eventually enter into human's body system causing various health problem.

2. Arsenic on Poultry

Arsenic is a chemical found in the environment that has a significant impact on the health of animals, including poultry [34]. Poultry in locations afflicted by arsenic exposure are exposed to hazardous levels of the deadly metal, much like animals in general [35]. Sources of arsenic pollution include feed ingredients, contaminated drinking water, vegetables, grasses, plants, and air emissions; the first four are the primary sources of arsenic [36].

Acute arsenic poisoning in chicken results in hypothermia, watery diarrhea, increased salivation, stomach pain, and circulatory collapse [37, 38]. Long-term effects may include sores resembling gangrene, cancer, and carcinomas of the skin, liver, kidneys, and lungs [39, 40]. Oxidative stress, which is caused by Arsenic-induced liver damage, is one of the most widely accepted theories for As-induced toxicity. Oxidative stress produces reactive oxygen species (ROS) [41].

3. Cadmium on Poultry

Cd (Cadmium) is a significant environmental contaminant that is continuously released into the environment from industrial and natural sources [42, 43]. Anthropogenic sources include the smelting of copper and nickel, the burning of fossil fuels, the creation of phosphate fertilizers from rocks with varying Cd concentrations, and the application of sewage sludge to soil. Lead (Cd) is released into the land and water, where it builds up in biogenic species via food chains and endangers the health of chickens. Food and drinking water are the two main ways that cadmium might somewhat enter the bodies of poultry animals [44].

Following its bloodstream binding to metallothionein, cadmium is delivered to target tissues where it accumulates [45]. Cd has teratogenic consequences in various animals, including chickens, such as appendage deformities, ear abnormalities, and gastrointestinal problems [46, 47]. In addition, exposure to Cd can cause eosinophilia, osteoporosis, chronic rhinitis, anemia, and non-hypertrophic emphysema [48, 49]. When blood levels of Cd surpass the capacity of metallothionein to bind it, free Cd causes the generation of lipid peroxidases and free radicals, which are detrimental to the kidneys and liver [50]. Poultry that consume large amounts of Cd produce fewer eggs due to histopathological damage, which also lowers feed intake and makes them more susceptible to stress [51].

4. Mercury on Poultry

One of the most effective neurotoxins is mercury (Hg), which can have a variety of detrimental impacts on an animal's or human's health [52]. Although methyl mercury is recognized as the most hazardous type, mercury (II) is more commonly and abundantly found in the environment and can have severely detrimental effects on poultry [53]. The primary producers of mercury are the paper, chemical, paint, pesticide, and fungicide industries, in addition to geothermal steam used to produce power [54]. When mercury was first used in medicine, it was found to have extremely harmful effects on both humans and animals, therefore this medicinal application was discontinued [55].

Poultry exposed to toxic quantities of mercury may experience anemia and slowed growth rate. Generally speaking, young, growing chickens are more vulnerable than adults to the harmful effects of prolonged exposure to mercury [56, 57]. Hg-induced toxicity in immune cells is primarily caused by the generation of oxidative stress, nitric oxide suppression, and cytokine profile modification [58]. Activated immunity should be taken into account when evaluating the impact of mercury exposure on the immune system in poultry, as it plays a more significant role in disease susceptibility. Exposure to mercury can cause harm to tissues and organs, and in poultry, it is absorbed and dispersed in the liver and kidneys [59]. Deposited mercury (Hg) in the

organ of poultry eventually enter into human's body system causing serious health problems.

5. Pesticide Effects on Human Health as a Result of Chicken Feed

After pesticides are sprayed on agricultural crops, residues may still be present in food. Consequently, pesticide residues might occasionally be found in chicken feed. These chemicals have been found in several studies to be present in farm eggs and chicken meat. Furthermore, these tainted pesticides have harmful impacts on human health when applied on meat and eggs.

519 samples of chicken meat, eggs, and beef and lamb meat were tested for the presence of organochlorine pesticide residues (OCP) in a study conducted in Jordan. OCP residues were found in 28% (38/134), 20% (23/115), and 49% (131/270) of the meat, chicken, and egg samples that were tested [60]. Pesticide residues in poultry meat can have a number of negative health impacts on people. It can lead to cancer and have an impact on the neurological and reproductive systems. Exposure to pesticides may result in fetal mortality, birth deformities, and neurological problems.

6. Antibiotics' Effects on Human Health that in Chicken Feed

Since 1950, antibiotics have been crucial in preserving the health of chicken chicks. Every year, around 45% of the antibiotics manufactured in the US are given to animals [61]. Antibacterial medications have been extensively used in chicken feed at subtherapeutic dosages over the past 30 years. The growth rate of the chicks as well as feed conversion were enhanced by the subtherapeutic administration of antibiotics. It considerably decreased the morbidity and mortality of sick chicks. In the production of chicken, the use of antibiotics in drinking water is likewise growing more and more significant. The widespread use of antibiotics caused the resistance to develop, but there is no clear proof that the subtherapeutic use of antibiotics in animal feed is related to this resistance.

However, concerns about the use of subtherapeutic antibiotics in chicken feed and their potential impact on human health were raised. Due to the possibility of endangering human health, the Food and Drug Administration (FDA) has suggested banning several antibiotics at subtherapeutic doses in feed. In developed nations, the use of therapeutic antibiotics is only allowed for situations in which no other kind of care has proven effective. Veterinarians examine the birds both before and after giving them antibiotics [62].

7. Radioactive Substance in Poultry

Cosmic waves are radiations that originate from various sources outside of the biosphere and are always present in the Earth's atmosphere [63]. Therefore, a constant little amount of various radiations known as natural background radiations are present in all living

things on Earth. Nuclear power plants, nuclear weapons, and medical procedures all use radioactive materials as a result of advancements in nuclear science technology [64]. Radiation from soil, air, and groundwater can reach fodder crops, which are used to manufacture poultry feed. Radium, thorium, and uranium are present in large amounts in the rock phosphates used to make fertilizers. These fertilizers pollute the soil by releasing radon, a byproduct of uranium that has decayed. The crop is finally being contaminated by the air and groundwater. According to a 2011 study done in Algeria, the soil treated with phosphate fertilizers had higher radioactivity than the soil treated with no fertilizer at all [65]. Additionally, 500 million curies of radon are released by ground water each year into the globe, serving as an indirect source of radionuclides [66]. When contaminated crops or water is used to make poultry feed, radioactive substance can be transferred to humans and animals [67]. A person's internal radioactivity will rise if they consume food tainted with radionuclides. Internal tissues will be exposed to radiation at a higher rate as a result. As humans consume meat and eggs, it is necessary to closely check chicken feed for the presence of radioactive substances that could pose a health risk to humans.

8. CONCLUSION

Due to ongoing exposure to heavy metals, bioaccumulation of As, Pb, Cd, and Hg takes place in a variety of organs in chickens, primarily the kidneys, liver, reproductive organs, and lungs. This puts human health at risk when consuming chicken or poultry animals. These heavy metals have an impact on a number of poultry organs, starting with the liver and moving on to the kidneys, brain, and reproductive system. Oxidative stress is caused by these heavy metals' overproduction in poultry. To reduce the hazards to human health connected with the use of animal products and the contamination of the atmosphere by manure, heavy metals in animal feed should be completely eliminated or their use as supplements should be regulated.

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