

Carbon Monoxide Poisoning in a Broiler Breeder flock: case report

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Abstract

Carbon monoxide (CO) is a colorless, odorless, and tasteless gas that can rapidly cause death in both humans and animals. CO poisoning in poultry under field conditions is rarely reported, and the associated clinical and pathological findings are often nonspecific. Cases of carbon monoxide poisoning are far more numerous than reported and remain a high risk to both chickens and farm workers. The present study describes a case of CO poisoning in a poultry production. Broiler breeder chicks were placed on straw

litter in a poultry house. Heating during the first weeks of life was provided by poorly maintained, outdated radiant heaters connected to butane gas cylinders. The first signs of poisoning appeared during the second week of age, resulting in an increase mortality rate over a five-week period. Clinical signs included ataxia, unsteady gait, convulsions, and death occurring within a few hours. Lesions were exclusively localized in the pancreas and were associated with narrowing of the duodenum. Blood glucose levels in affected birds and CO concentrations in the poultry house were measured during the poisoning period. Removal of the heaters and ventilation of the poultry house at week 5 led to a marked reduction in mortality. The farmer, who intermittently entered the birds' living area, reported mild dizziness. This study demonstrates that CO poses a significant risk to both poultry and farm workers, highlights the importance of field detection under production conditions.

Keywords: Carbon monoxide, Chicks, Clinical signs, Lesions, Mortality

1. Introduction

CO is a colorless, odorless, and tasteless gas that can rapidly cause death in both humans and animals, with no sensory warning signs of its presence. To complete the sensor methods, many non-invasive gases are provided based on nanotechnology [1, 2]. Stiles described as early as 1936, a case of carbon monoxide poisoning in mature hens due to a smoky kerosene lamp used to keep water from freezing in a drinking fountain [3]. Since 1952, numerous cases submitted to the Alberta Veterinary Laboratory in Edmonton have been diagnosed as carbon monoxide poisoning [4]. Incidents of CO exposure have also been reported in more recent, well-insulated poultry buildings during colder months, where poor maintenance of gas heating systems was identified as a major contributing factor [5]. Most experimental studies on CO in chicks have been conducted using embryonated eggs as an avian model to investigate the effects of this gas in humans [6, 7, 8].

To our knowledge, CO poisoning in poultry under field conditions is rarely reported, and the associated clinical and pathological findings are often nonspecific. This study therefore aims to provide a detailed description of the clinical signs, lesions, and potential risks to farm workers associated with a field case of CO poisoning in poultry.

2. Case presentation

In December 2024, increased mortality was reported in a flock of broiler breeder chicks introduced at one day of age onto a farm located in the Annaba region in eastern Algeria. Outdoor temperatures ranged from 10°C to 15°C, with relative humidity between 70% and 75%. The poultry house measured 40 m in length, 10 m in width, and 5 m in height, and was equipped with lateral openings and air extractors that were intentionally sealed to maintain optimal indoor temperature conditions. Indoor temperature was maintained at 30°C to 32°C during the first week, then decreased by 2°C per week to reach 18°C to 20°C for the remainder of the rearing period. Meanwhile, relative humidity increased from 50% to 60% at the beginning of rearing to 70% to 75% after the second week of age.

During the starter phase (1-15 days) and the growth phase (15 days to 18 weeks), a total of 5,942 chicks (5,192 females and 750 males) were housed at stocking densities of 60 birds/m² and 30 birds/m², respectively, in an area separated from the rest of the building by a black plastic partition. The litter consisted of 10 cm of unchopped straw. Six radiant heaters, each with a capacity of 1,000 birds and connected to butane gas cylinders, were evenly distributed throughout the rearing area to maintain adequate temperature. These

heaters had been in use for approximately ten years and were cleaned and disinfected with bleach before each new flock.

Day-old chicks were sourced from a hatchery located in central Algeria, and routine laboratory analyses conducted on day one confirmed the good sanitary status of the flock. Feeding, technical management parameters, and biosecurity measures were reported to be rigorously applied.

2.1 Laboratory investigations

Glucose levels of blood samples collected from affected birds were measured with Vital Check MM 1200(SPA vital care, Algeria). For measurement of CO levels in the poultry house, a handheld CO monitor (extreme detector mono-gas, BM technology, Canada) was used. Serological analyses (HI test, ELISA) and bacteriological cultures on selective media were used for infectious diseases diagnostic.

2.2 Poisoning evaluation CO

Mortality during the first week was within normal limits, with 17 chicks (0.25%) dying due to accidental causes. From day 8 onward, mortality increased sharply, reaching a total of 175 dead birds (2.94%) during the second week. Most dead birds were found beneath the radiant heaters. During the third and fourth weeks of age, peaks of approximately 200 morbid birds and around 100 deaths per day were recorded across the entire housing area. The total number of deaths during the first five weeks reached 1,237 birds, corresponding to an overall mortality rate of 20.82 %.

Given the high mortality rate, highly pathogenic infectious diseases, particularly Newcastle disease and salmonellosis caused by *Salmonella pullorum* *gallinarum*, were initially suspected. These conditions were subsequently ruled

out through appropriate laboratory diagnostic investigations. In parallel, antibiotic and vitamin treatments were administered for five days, with no improvement in the health status of the flock.

All affected and dead birds exhibited similar clinical signs and lesions. Observed signs included anorexia, prostration, somnolence, reduced weight gain, unsteady gait, ataxia, lateral or dorsal recumbency, and convulsions followed by death (Figure 1) within 2 to 4 hours.



Figure 1. Three-week-old chicks showing somnolence (black arrows), lateral and dorsal recumbency (white arrows), and impaired growth (red arrows)

Lesions observed in dead birds were exclusively localized in the pancreas (pancreatitis), associated with narrowing of the duodenal loop (Figure 2).



Figure 2. Pancreatic lesions with narrowing of the duodenum in chicks that died at 3 weeks of age, compared with the duodenum of a healthy chick of the same age (arrow)

Based on these clinical and pathological findings, blood samples were collected from affected birds to measure glucose levels, which ranged from 0.4 mg/dL to 0.6 mg/dL, compared with a reported normal value of 1 mg/dL. This finding raised suspicion of carbon monoxide poisoning, particularly after both the farmer and the attending veterinarian reported mild headaches and dizziness following brief exposure to the birds' living area.

Measurement of CO levels using a handheld CO monitor revealed concentrations of 1,800 to 2,200 ppm at litter level beneath the heaters, 1,400 to 1,600 ppm in the ambient air, and 600 to 700 ppm at 1.5 m above ground level. Removal of the heaters and intensive ventilation of the poultry house during the sixth week led to a definitive reduction in the number of affected birds.

3. Discussion

Studies on CO exposure in chicks are limited, and most have been conducted using embryonated eggs as an avian model to investigate the effects of this gas in humans [6, 7, 8]. As early as 1958, pathologists reported difficulty in diagnosing carbon monoxide poisoning due to insufficient information on exposure levels [4].

In the present study, mortality remained within normal limits during the first week of age, likely reflecting insufficient accumulation of CO to induce clinical signs. During the second week, most dead birds were found beneath the radiant heaters, where emissions from incomplete combustion were presumably highest (1,800-2,200 ppm). In the third and fourth weeks, mortality increased further, with dead birds distributed throughout the housing area, suggesting a more generalized accumulation of CO (1,400-1,600 ppm).

Previous studies have reported that CO concentrations of approximately 600 ppm can induce clinical distress in poultry within 30 minutes, whereas levels between 2,000 and 3,600 ppm may be fatal within 1.5 to 2 hours [9]. Similarly, Bruger-Picoux [10] reported that exposure to 750 ppm for one week reduces carcass quality, while concentrations of 2,000 ppm for 4 hours may result in mortality rates of 63% to 75% in chicks.

Clinical and pathological manifestations of CO poisoning vary depending on both concentration and duration of exposure, and diagnosis based solely on these findings remains challenging. In this study, all affected birds exhibited consistent clinical signs, including unsteady gait, loss of balance, recumbency, and convulsions, as well as pancreatic lesions.

In contrast, Carlson and Clandinin [4] described clinical signs such as dyspnea, nephritis, and hepatic degeneration, while Stiles [3] reported

abnormally bright red coloration of the lungs and blood tissues in the examined sample led to spectroscopic analysis of the blood. This observation allowed for easy visualization of the double CO-hemoglobin bands in the D-E region of the spectrum. Penney et al. [11] demonstrated that alterations in blood glucose under CO exposure may reflect metabolic disruption, which could be associated with pancreatic involvement, although this relationship remains to be clarified. Peckham [12] reported that bright red blood is commonly observed at necropsy and that sublethal CO exposure may impair growth performance, consistent with the reduced weight gain observed in this study.

In this case, the health impact on the farmer could have been more severe if not for the building height (5 m) and relatively high humidity levels (70-75%). Under these conditions, cooler, denser air may have contributed to the accumulation of CO near the litter, while warmer air with lower CO concentration (600 -700 ppm) rose toward the upper part of the building. Breurec et al. [5] reported ten CO-related incidents between 1994 and 1998 affecting 25 individuals. Poultry were less frequently affected, although in one incident, 3,500 chicks were found dead near heating equipment. In a separate study conducted between 1996 and 1997, the same authors reported repeated exceedances of a 50-ppm threshold among workers equipped with CO detectors.

The findings of this study provided a detailed description of the associated clinical and pathological findings, together with field measurements of blood glucose and ambient CO concentrations. This interpretation is supported by the elevated CO concentrations measured at litter level and in ambient air. These observations may assist farmers and veterinarians in recognizing carbon

monoxide exposure under field conditions. The installation of CO detectors in high-risk poultry facilities represents a practical and effective measure to enhance both animal welfare and worker safety.

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Ethics approval:

The study was approved by the Ethics Committee of Department of Veterinary Sciences, Chadli Bendjedid University, El Tarf, Algeria, in accordance with international animal welfare Standards, code15/2025.

Authors' Contribution

M.Z: Investigation, manuscript writing. L.M: study design, critically revised the manuscript. S.M: contributed to data collection and provided the materials. Z.A: Drafting of the manuscript. A.T.D and R.B: supervised the project, and edited the manuscript. A.H: Analysis and interpretation of data

Conflict of Interest

The authors hereby declare that there is no conflict of interest.

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Data Availability

All data supporting the findings of this study are available within this article.

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