# 2. Avian influenza and the virus that causes it

Avian influenza is caused by influenza viruses which are common in wild birds and occasionally infect poultry. When poultry are infected, they may have no disease, mild disease or very severe disease. Chickens, quail and turkeys are especially susceptible while ducks more commonly show no disease, but act as a reservoir for the virus. Other poultry species, including guinea fowl and pheasants, and also ostriches, can become affected. While generally wild birds are not clinically affected by the AI viruses that they carry, occasionally they can suffer disease. This has been observed in Asia and parts of Europe as a result of infection with the H5N1 virus and may be because they have become infected with the virus from domestic birds.

Influenza viruses have two main surface antigens, haemagglutinin (H) and neuraminidase (N). There are many H and N subtypes, but historically highly pathogenic avian influenza viruses have been either H5 or H7, and to a lesser degree H9. The avian influenza virus currently causing the major epidemic in Asia is H5N1, with some occurrences of H5N2 being reported as well. The virus causing disease in Pakistan in recent years is H7N3 and H9N2. AI viruses are also classified by pathotype – highly pathogenic (HPAI) and low pathogenic (LPAI) – a biological characteristic of the virus' virulence in chickens. Currently, the pathotype definition has been expanded to include the genetic sequence coding for basic amino acids in the cleavage site of the H protein. All AI viruses that have these sequences at the critical site are considered notifiable and the viruses are denoted as HPNAI (highly pathogenic notifiable avian influenza) and LPNAI.

## 2.1. CLINICAL SIGNS

The clinical signs of AI infection are variable and influenced greatly by the virulence of the viruses involved, the species infected, age, concurrent viral or bacterial disease and the environment. The virulence exhibited in chickens can vary during an outbreak.

### Infection with non-pathogenic viruses

- No clinical signs in infected birds, with seroconversion.
- Some of these viruses have the potential to become virulent through genetic mutation.

### Infection with low or mild pathogenic viruses

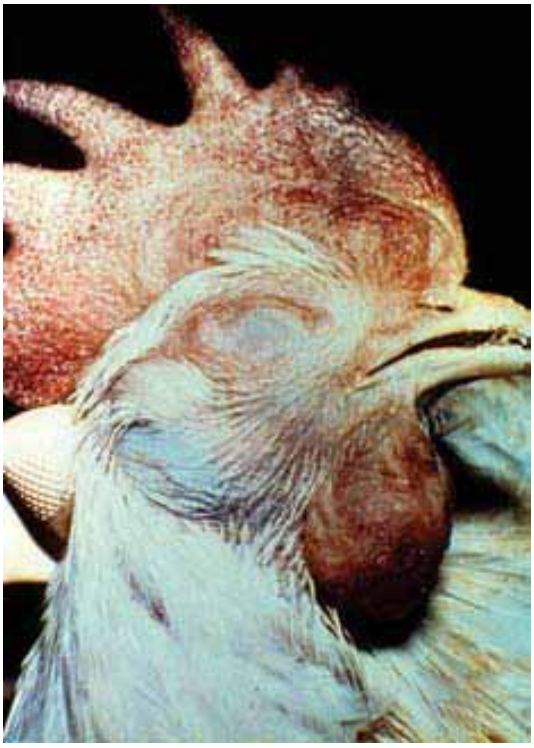
- Clinical signs in chickens and turkeys range from inapparent to mild or severe respiratory disease and can be confused with infectious laryngotracheitis and other respiratory tract infections.
- Mortality ranges from 3 percent in caged hens (layers) to 15 percent in meat chickens (broilers).

- Egg production in layers can drop sometimes to 45 percent of the expected egg yield of a large flock, returning to normal levels of production in 2–4 weeks.
- Mutation to virulence has been demonstrated in outbreaks.

## Infection with highly pathogenic viruses

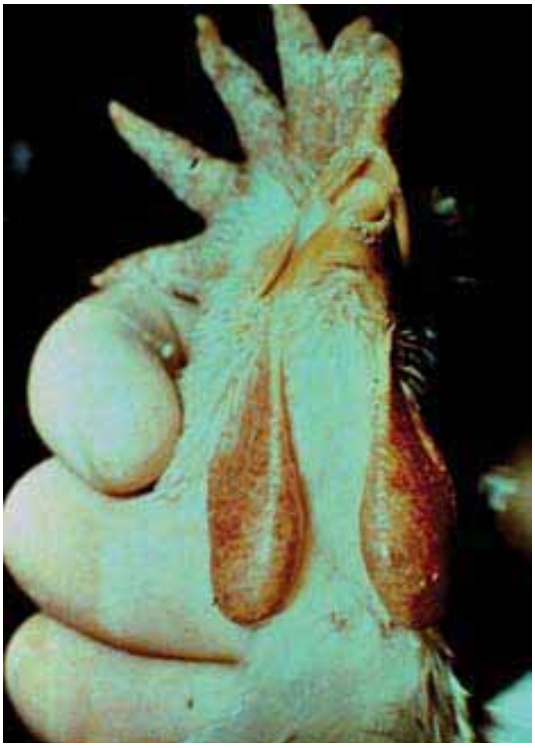
- In peracute cases involving sudden death, as in the 2004-5 outbreak in Viet Nam, clinical signs may not be seen and mortalities occur within hours after onset of depression. Overall mortality rates for peracute/acute cases nearing 100 percent have been reported.
- In acute cases, mortalities occur as early as 24 hours after the first signs of the disease, and frequently within 48 hours. In other cases, more diverse visible signs are seen and mortalities can be delayed for as long as a week.
- Clinical signs in chickens and turkeys include severe respiratory distress with excessively watery eyes and sinusitis, cyanosis of the combs, wattle and shanks, oedema of the head and eyelids, ruffled feathers, diarrhoea and nervous signs.
- Eggs laid after the onset of illness frequently have no shells.
- Some severely affected hens may recover, but rarely come back into lay.

The disease in turkeys is similar to that in chickens, but is often complicated by secondary bacterial infections such as those due to fowl cholera (*Pateurella multocida*), turkey coryza (*Hemophilus gallinarum*), or colibacillosis (*Escherichia coli*).



CREDIT: USDA

*Oedamatous cyanotic comb and wattle of a chicken with Higly Pathogenic Avian Influenza*



CREDIT: USDA

*Oedematous wattles*

## 2.2 GROSS PATHOLOGY

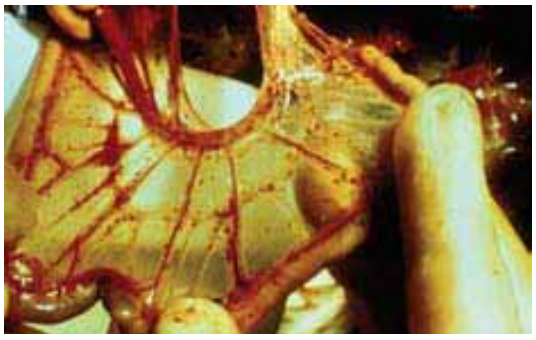
In many cases, poultry dying from the peracute form of the disease lack visible gross pathological lesions. With acute infections in chickens, there is severe lung congestion, haemorrhage and oedema in dead chickens; other organs and tissues appear normal. More varied visible lesions are seen in chickens surviving 3 to 5 days, including congestion and/or cyanosis of the comb and wattles and swollen heads. The changes in the combs and wattles progress to depressed areas of dark red to blue areas of ischaemic necrosis. Internally, the characteristics of acute infections with viruses causing HPAI are haemorrhagic, necrotic, congestive and transudative changes. The oviducts and intestines often have severe haemorrhagic changes.

As the disease progresses, the pancreas, liver, spleen, kidney and lungs can display yellowish necrotic foci. Haemorrhages (petechial and ecchymotic) cover the abdominal fat, serosal surfaces and peritoneum. The peritoneal cavity is frequently filled with yolk from ruptured ova, associated with severe inflammation of the airsacs and peritoneum in birds that survive 7–10 days. Haemorrhages may be present in the proventriculus, particularly at the junction with the ventriculus (gizzard).

In cases due to mild pathogenic avian influenza viruses, lesions may be seen in the sinuses characterised by catarrhal, serofibrinous, mucopurulent or caseous inflammation. The tracheal mucosa may be oedematous with exudates varying from serous to caseous. The airsacs may be thickened and have fibrinous to caseous exudates. Catarrhal to fibri-

*Oedematous wattles dissected*

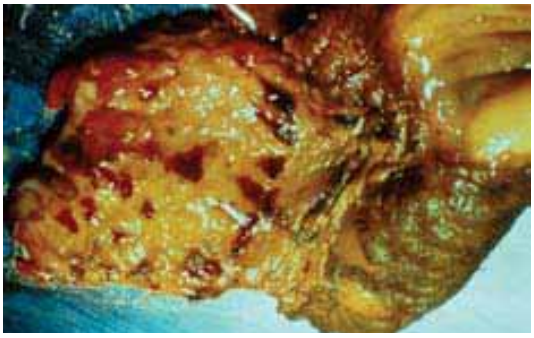
*Haemorrhage in the mesentery of the small intestine*



*Large haemorrhages in the fat on the serosal surfaces of the abdominal organs*

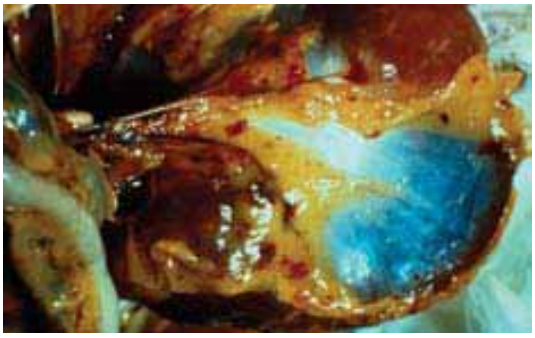
*Haemorrhage in the muscle and the fat around the heart*

CREDITS: USDA



CREDIT: USDA

*Ecchymotic haemorrhages in the proventriculus.*



CREDIT: USDA

*Haemorrhage in the muscle and fat around the gizzard.*

nous peritonitis and egg yolk peritonitis may be seen. Catarrhal to fibrinous enteritis may be seen in the caeca and/or intestine, particularly in turkeys. Exudates may be seen in the oviducts of laying birds (Easterday *et al.* 1997). Histopathological lesions seen in the gross changes described above are not definitive for HPAI, although vasculitis in the brain and other organs may be highly suggestive of the disease.

## 2.3 DIFFERENTIAL DIAGNOSIS

The following diseases must be considered in the differential diagnosis of virulent AI:

- Other diseases causing sudden high mortality
  - Newcastle disease
  - Infectious laryngotracheitis
  - Duck plague
  - Acute poisonings
- Other diseases causing swelling of the combs and wattles
  - Acute fowl cholera and other septicaemic diseases
  - Bacterial cellulitis of the comb and wattles

Less severe forms of the disease may be confused with, or complicated by, many other diseases with respiratory or enteric signs. HPAI should be suspected in any disease outbreak in poultry that persists despite the application of preventive and therapeutic measures for other diseases or when the epidemiological context is highly suggestive of the introduction of the infection.