Newcastle Disease in the Poultry Industry
A Growing Threat to Commercial Poultry

Introduction

Newcastle disease (ND) can lead to death in poultry, and is one of the greatest causes of economic loss in poultry production world-wide. In recent experiments, ND was tested as a means of transferring from non-poultry avian species to poultry (Kinde et al., 2005), tested for its survival in a poultry environment following the removal of the infected chickens (Kinde, Utterback, Takeshita, & McFarland, 2004), and tested for a temperature at which the virus might be inactivated during egg pasteurization (Swayne & Beck, 2004).

Today, Newcastle disease is a topic of rising concern because it poses the constant threat of introduction into disease-free areas. Scientists are working to develop new vaccination programs to control disease spread, but a cure for the disease is yet to be discovered. The purpose of this research brief is to increase awareness about the threat of Newcastle disease on commercial and backyard poultry flocks.

Background

Newcastle disease has been present throughout the 1900s worldwide. Recent outbreaks of ND in Australia in 1998, 1999, and 2000 (Westbury, 2001) have given scientists a reason for concern. The virus was first diagnosed in the United States in California in 1950 among imported pheasants. Since 1950, there have been outbreaks confirmed in Ohio, New York, Texas, Massachusetts, New Mexico, Florida, Connecticut, Puerto Rico, Illinois, and Florida (Kinde, Hullinger, et al., 2005).

Dr. John El-Attrache, assistant professor of veterinary pathobiology at the College of Veterinary Medicine at Texas A&M, said the California outbreak was believed to have originated from gamecocks that were smuggled into eastern Los Angeles (Chenault, 2003). ND remains in California and continues to make its presence in other states.

In one of the biggest poultry farms in Ethiopia, where the country depends greatly on poultry production for exportation, at least nine outbreaks have been reported since 1984 (Nasser et al., 2000). Although they routinely vaccinated large commercial flocks with Hitchner B1(HB1) and La Sota strains, village chickens were not vaccinated because the use of conventional vaccines to control ND was physically too difficult.

Conventional vaccination involved “maintaining a cold chain, catching and handling individual birds, using skilled vaccinators and repeating the whole procedure sufficiently often to ensure that every bird receives at least two doses of vaccine at different times” (Nasser et al., 2000, p. 27).

Symptoms

Newcastle disease is caused by Newcastle disease virus (NDV), and can be divided into five pathotypes (Alexander, 2003, as cited in Nakumura, Ohta, Abe, Imai, & Yamada, 2004). Velogenic viscerotropic Newcastle Disease virus (VVNDV), known as the “Doyle’s form,” is lethal and causes hemorrhagic lesions in the digestive tract (Nakumara et al.). According to Kinde, Hullinger, et al. (2005), clinical signs include depression, anorexia, lethargy, respiratory distress, coughing, gasping, greenish watery diarrhea, and fever, and can cause death in unvaccinated birds.

El-Attrache stated that “Even though commercial poultry are vaccinated, protection does not last for extended periods and birds become susceptible again” (Chenault, 2003, Exotic Newcastle Disease section, para. 3).

Other pathological features of Newcastle disease seen in chickens are lymphoid, vascular,
respiratory, neural, and reproductive lesions (Alexander, 1997, as cited in Nakumura et al., 2004).

NDV also causes conjunctivitis (Cheville et al., 1972; Spalatin et al., 1973; Katoh, 1977; & Alexander, 2003, as cited in Nakumura et al., 2004) and induces conjunctivitis in humans (Hales & Ostler, 1973, as cited in Nakumura, et al, 2004). Nakamura et al. tested the pathogenesis of conjunctivitis in 3-week-old specific-pathogen-free chickens that had been inoculated with different strains of NDV.

In the chickens inoculated with VVNDV, mild to severe lesions were observed. In mild lesions, symptoms such as vascular necrosis and vascular congestion were observed in the conjunctiva, and in more moderate lesions, hemorrhages and macrophages were observed. Nakumura et al. (2004) suggested that “damage to blood vessels may be important for the development of moderate to severe conjunctivitis of chickens inoculated with VVNDVV,” and that NDV “has a high affinity for the conjunctiva” (p. 375). It is therefore suggested that detecting conjunctivitis with vascular necrosis may be useful in diagnosing VVNDV.

Prevention

Although there is no cure for the disease, Swayne and Beck (2004) stated that Newcastle disease is a heat labile virus, meaning that it can be inactivated at a certain temperature. In their experiment, homogenized whole egg, liquid egg white, and salted yolk samples from embryonic chicken eggs were contaminated with the five viruses (including ND) and processed for virus isolation and titration. The samples were pasteurized to calculate the time it took to reduce the disease at a specified level and the temperature required to inactivate the virus.

Swayne and Beck (2004) concluded that virus inactivation was inversely related to temperature, but was directly related to virus tire. They stated that “the ND viruses were more resistant to heat inactivation… than were the AI viruses” (p. 514). They also stated that “heat application to egg products artificially infected with low or high virulent AI or ND viruses can result in virus inactivation when using temperatures and times of heat application similar to those used in commercial pasteurization of liquid egg products” (Swayne & Beck, 2004, p. 515). Therefore, pasteurization may be an effective way of inactivating ND once it is present in eggs.

Kinde & Utterback (2004) suggested that the style of housing may account for much of the disease’s presence, due to sanitation. In their experiment, environmental drag manure samples from two ranches were tested for ND survival times outside the host associated with temperature, moisture, and environment. Several samples taken from the first ranch that had a manure pit with concrete floors tested positive for ND. All samples taken from the second ranch that had an automatic manure belt disposal system tested negative for the virus during the entire sampling time. Therefore, using a high quality manure-handling system, such as a manure belt disposal system, may prevent disease spread if a flock becomes infected with ND.

Nasser et al. (2000), experimented with vaccines in Ethiopia, particularly the NDV-I vaccine, to determine its effectiveness against the Ethiopian velogenic strain of NDV. By testing unvaccinated control chicks and chicks vaccinated with NDV-I mixed with untreated sorghum and barley, he was able to observe the number of chicks that survived and the number that were challenged at five different weeks. As seen in the table below, his results indicated that chickens vaccinated with the thermo stable NDV-I vaccine were substantially protected against a strain of NDV. He also stated that “In countries with a high prevalence of virulent ND, mesogenic strains of NDV are generally preferred for booster vaccinations” (Nasser et al., p. 32).
Geometric mean haemagglutination inhibition (HI) antibody titres and response to challenge with virulent Newcastle disease virus in chickens vaccinated at 2 and 5 weeks via untreated feed or intraocularly

<table>
<thead>
<tr>
<th>Vaccination</th>
<th>HI antibody titre at weeks</th>
<th>Number survived/Number challenged at week 8</th>
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<tbody>
<tr>
<td>NDV-I Sorghum 0 (a)</td>
<td>3.5 1.3 0.1 0.1</td>
<td>2/20</td>
</tr>
<tr>
<td>NDV-I Sorghum 14 (b)</td>
<td>3.5 1.1 n.d. n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td>NDV-I Barley 0 (a)</td>
<td>3.5 1.4 0.1 0.1</td>
<td>2/20</td>
</tr>
<tr>
<td>NDV-I Barley 14 (b)</td>
<td>3.5 1.3 &lt;1.0 &lt;1.0</td>
<td>1/20</td>
</tr>
<tr>
<td>Unvaccinated Control</td>
<td>3.5 1.4 0.1 0.1</td>
<td>0/20</td>
</tr>
<tr>
<td>NDV-I Eye drop</td>
<td>3.5 1.4 3.2 3.3</td>
<td>18/19</td>
</tr>
</tbody>
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(a) untreated, given orally immediately after mixing with the NDV-I vaccine
(b) untreated, given orally 14 h after mixing with the NDV-I vaccine
(n.d.) not done


El-Attrache said he is working to develop vaccination programs to control and prevent the spread of disease in both commercial and backyard flocks “by using tests that can detect the RNA of the pathogen” (Chenault, 2003, Exotic Newcastle Disease section, para. 9). According to Chenault (2003), he is also is helping the Texas Veterinary Medical Diagnostic Laboratory prepare for ND in Texas by establishing a new method that would “help the lab respond more quickly to a flood of cases” (para. 10).

Discussion

According to Westbury (2001), in 1998 a NDV was isolated from chickens experiencing late respiratory disease on a farm in New South Wales. The molecules of the isolate were analyzed and provided new information. The isolate, which was termed “Peat’s Ridge,” had an amino acid sequence that had not been previously detected. Two months later, a strain of NDV collected from chickens in Dean Park, South Wales was analyzed and proved to have a “deduced nine amino acid of HN protein and such nucleotide sequence similarity with Peat’s Ridge isolate [proving that it was] very closely related to it” (Westbury, p. 7).

Further related incidents linked to this case initiated a “stamping-out” control program, a surveillance program intended to detect spread of the virulent virus. Westbury’s study provided some idea of the risk of further outbreaks of virulent ND if the Peat’s Ridge strain is the precursor of NDV, and suggested that it might be an evolving pathogen.

Because infected birds can spread the virus, poultry farm owners should be aware of the economic damages Newcastle disease can impose. According to Chenault (2003), “infected flocks are immediately culled, a practice that could be financially devastating to an industry employing more than 11,000 Texans and generating annual cash receipts of more than $1.4 billion” (Chenault, Exotic Newcastle Disease section, para. 5).

Poultry producers in Texas should be especially concerned since ND was found in El Paso in early April. This made it difficult for Texas' commercial chicken, egg and turkey producers to export to other markets. Chenault (2003) also stated that at least 12 countries, including Mexico, have either banned imports of poultry, eggs or poultry meat, or have placed stringent requirements on products.
Audience

Poultry farm owners should have a full understanding of ND in order to appreciate the content of this research brief. This information is beneficial because it provides an explanation of the symptoms of infected poultry, recommends housing styles, and provides other precautionary measures that poultry farm owners can take in order to control disease spread and prevent it from entering their flocks.

References

http://agcomwww.tamu.edu/lifescapes/summer03/bioinvaders.htm


