Strategies of Newcastle Disease Vaccination for Commercial Ostrich Farms in Japan

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ABSTRACT. Strategies of Newcastle disease (ND) vaccination were demonstrated in a commercial ostrich farm in Japan. Three of 13 seven-month-old ostriches kept in a pen were vaccinated with a live ND vaccine by eye dropping for the 1st and 2nd vaccinations and spraying for the 3rd to 5th vaccinations. Antibodies against ND virus (NDV) were detected in all of the unvaccinated ostriches and seven-month-old ostriches kept in a pen were vaccinated with a live ND vaccine by eye dropping for the 1st and 2nd vaccinations and spraying for the 3rd to 5th vaccinations. Antibodies against ND virus (NDV) were detected in all of the unvaccinated ostriches and seven-month-old ostriches kept in a pen were vaccinated with a live ND vaccine by eye dropping for the 1st and 2nd vaccinations and spraying for the 3rd to 5th vaccinations. Antibodies against NDV were detected in all of the unvaccinated ostriches.

NOTE

NEWCASTLE

DISEASE

VACCINATION

FOR

COMMERCIAL

OSTRICH

FARMS

IN

JAPAN

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ABSTRACT. Strategies of Newcastle disease (ND) vaccination were demonstrated in a commercial ostrich farm in Japan. Three of 13 seven-month-old ostriches kept in a pen were vaccinated with a live ND vaccine by eye dropping for the 1st and 2nd vaccinations and spraying for the 3rd to 5th vaccinations. Antibodies against ND virus (NDV) were detected in all of the unvaccinated ostriches and these data may be helpful for ND vaccination management in ostrich farms.

These data indicate that NDV may be transmitted from vaccinated to unvaccinated ostriches in the flock and that the virus may be sustained for a certain period in the flock. These data may be helpful for ND vaccination management in ostrich farms.

KEY WORDS: Newcastle disease, ostrich, vaccination.

Newcastle disease (ND) is one of the most important infectious diseases in birds throughout the world. The causative pathogen, ND virus (NDV), is an avian paramyxovirus serotype 1 (APMV-1) virus of the genus Avulavirus, subfamily Paramyxovirinae, family Paramyxoviridae, order Mononegavirales [2, 9]. Because of the severe nature of the disease and the associated consequences, ND is included as an Office International des Epizooties (OIE) listed disease.

ND is a highly contagious viral infection of ostriches (Struthio camelus var. domesticus) and manifests itself clinically as nervous aberrations resulting even in 80% mortality in experimentally infected ostrich chicks [13]. This virus spreads to birds on a farm easily, either by aerosol or fecal-oral route, although feed vehicles and personnel can also act as mechanical carriers introducing the virus to uncontaminated areas [1].

In countries that are leading producers and major exporters of ostrich products, such as South Africa, it is important to reduce the risk of NDV transmission by effective vaccination. Because of their size, longevity and rearing methods, problems to be overcome in achieving successful prophylactic vaccination of ostriches are quite different from those associated with vaccinating chickens and other poultry. Little is known about the immune response in ostriches; further, efficacy and potency tests have not been carried out, would be difficult to evaluate and would be extremely expensive [2].

Commercial ostriches were introduced into Japan since 1988, and the number of the birds was increased rapidly, reaching around 10,000 ostriches by 2003. Since ostriches are kept mainly in a free-range situation, they easily come in contact with wild birds and animals that may introduce some pathogens, including NDV. The major importance of an ND vaccination strategy, together with increasing ostrich husbandry in Japan, leads to a need for an optimal strategy in commercial ostrich farms. Hence, the Japan Ostrich Council (JOC) began an NDV vaccination campaign in 2004, in accordance with the findings of Sakai et al. [11], but ND vaccination at ostrich farms is still not common in Japan [10, 12]. However, after the ND vaccination campaign of the JOC, antibody titers against NDV in slaughter-aged ostriches became low [10]. This suggests that NDV vaccination could protect ostriches from field NDV infection and that the incidence of ND infection in ostrich farms seemed to have decreased after the ND vaccination campaign. It seemed that finding more effective vaccination strategies for ostrich farmers is useful. ND vaccination through drinking water would not work well for ostriches, as reported by Sakai et al. [11]. Vaccination by eye drop is difficult for older ostriches because of the size of their bodies, and vaccination by injection is apt to be disliked by an owner. In the present study, we demonstrated the temporal and vaccine-type-dependent interplay that may be useful for shaping an optimal vaccination procedure. Furthermore, we also demonstrated that transmission of the vaccine virus shed by vaccinated ostriches to collocated unvaccinated ostriches took place during the vaccination trial, as well as much later, due to ongoing apparent persistence of the virus, either biologically or environmentally, within a given flock or farm. All in all, the findings obtained may significantly enhance establishing an optimal vaccination strategy for commercial ostrich farms.

At a commercial ostrich farm (Farm A) in Kanagawa, Japan, 3 of 13 7-month-old birds kept in a pen were vaccinated with a live ND vaccine (B1 strain, Kyoto Biken, Kyoto,
At the fifth month post inoculation (mpi) (=2.5 months after the last vaccination), 2 ostriches from another farm where an ND vaccine had not been used were introduced to the same pen in which vaccinated birds were kept at Farm A. At 2 weeks post introduction, blood samples were collected for a VN test. Each of these 2 ostriches also had antibody titers detected by VN test (7.74 and 6.78) (Table 1).

Several researchers reported poor results using the hemagglutination inhibition (HI) test for ostrich sera. Allwright [4] considered false negative results to be a serious problem and recommended a microneutralization test or standard enzyme-linked immunosorbent assay (ELISA) test using biotinylated rabbit anti-ostrich immunoglobulin G antiserum. William et al. [20] considered the HI test to give a high incidence of false-positive results. In our previous study [12], heating, kaolin and chicken red blood cell treatment of ostrich serum samples reduced the number of false-positive reaction in the HI test, but there was no correlation between the VN test and the HI test. Since under experimental conditions, we already showed that ostriches vaccinated by eye dropping raised antibodies against ND using a VN test [11], we vaccinated ostriches by the same method.

At commercial farms, owners are sometimes not happy with injection by needles, especially blood collection, so we vaccinated only 3 ostriches in an ostrich pen. In the pen, vaccination of 23% (3 of 13) of the ostriches seemed to be sufficient for transmitting the vaccine virus to all of the remaining unvaccinated ostriches (10 birds). One serum sample from an unvaccinated ostrich (No. 2908) collected from the pen in which the 3rd vaccination by spraying took place and was found to be antibody positive. The serum collected from this ostrich showed an increased VN titer, from 6.2 to 20.8, after vaccination of the bird by spraying. These data indicate that spraying could significantly scale up immunity, while a similar effect was also attained by eye dropping. The increased antibody titers of birds (2907

Table 1. Virus neutralization (VN) titers of the investigated ostriches

<table>
<thead>
<tr>
<th>Ostrich number</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>3.5 mpv&lt;sup&gt;a&lt;/sup&gt;</th>
<th>4.5 mpv</th>
<th>5.5 mpv</th>
<th>6.5 mpv</th>
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<tbody>
<tr>
<td>No.2565</td>
<td>&lt;4</td>
<td>19.0</td>
<td>23.0</td>
<td>6.8</td>
<td>21.5</td>
<td>7.59</td>
<td>8.00</td>
<td>6.56</td>
<td>5.69</td>
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<tr>
<td>No.2905</td>
<td>&lt;4</td>
<td>17.5</td>
<td>19.0</td>
<td>20.0</td>
<td>26.91</td>
<td>26.45</td>
<td>20.16</td>
<td>5.98</td>
<td></td>
</tr>
<tr>
<td>No.2907</td>
<td>&lt;4</td>
<td>9.5</td>
<td>15.7</td>
<td>113.4</td>
<td>83.0</td>
<td>103.97</td>
<td>24.63</td>
<td>25.40</td>
<td>7.26</td>
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<tr>
<td>No.2908</td>
<td>-</td>
<td>-</td>
<td>6.2</td>
<td>20.8</td>
<td>18.1</td>
<td>k-</td>
<td>k-</td>
<td>k-</td>
<td>k-</td>
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<td>No.2920&lt;sup&gt;3&lt;/sup&gt;</td>
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<td>-</td>
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<td>-</td>
<td>7.73</td>
<td>7.46</td>
<td>7.25</td>
<td>5.98</td>
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<tr>
<td>No.2363&lt;sup&gt;3&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>6.84</td>
<td>k-</td>
<td>k-</td>
<td>k-</td>
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<tr>
<td>No.2636&lt;sup&gt;3&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.09</td>
<td>7.13</td>
<td>6.43</td>
<td></td>
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</tr>
<tr>
<td>No.2515&lt;sup&gt;3&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.5</td>
<td>6.56</td>
<td>&lt;4</td>
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<tr>
<td>No number&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>-</td>
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<td>-</td>
<td>7.74</td>
<td>4.15</td>
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</tr>
<tr>
<td>Tama-1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.78</td>
<td>6.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tama-2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
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</table>

a) Months post vaccination.  
b) No sampling.  
c) Unvaccinated ostrich.  
d) Unvaccinated ostrich that was introduced from another farm and kept in the same pen 2 weeks before blood collection.  
e) Sent to a slaughterhouses.
and 2908) after spraying suggested that VN titers of around 6–20 might be not enough to protect birds from NDV infection. Verwoerd et al. [18] challenged 10 unvaccinated and 10 vaccinated ostriches (>90 kg in weight and 10 months old) via the respiratory tract with an ND isolate shown to be extremely virulent in chickens. All 10 unvaccinated birds became sick, primarily with respiratory signs, and two died, but the vaccinated birds remained normal [18]. However, there were no data for serum VN titer in that paper.

Transmission of NDV between birds occurs through inhalation of droplets or ingestion of material such as feces, with the latter appearing to be the more important in the field [1]. The fact that two unvaccinated ostriches (Tama 1 and Tama 2) introduced at 2.5 months after the last vaccination also showed antibodies against ND suggests that the vaccine virus circulated in the flock or in the local environment for at least 2.5 months after the last vaccination. Unfortunately, sera from these birds could not be collected upon their introduction. These birds were hatched and kept at Tamagawa University before introduction and had not yet been vaccinated. Moreover, sera were collected and showed VN titers of 7.74 and 6.78 at 2 weeks post introduction and 4.15 and 6.91 at 6 weeks post introduction, respectively. These data suggest that the birds were naturally infected with the vaccine virus.

Usually, NDV is readily inactivated by heating. Some studies have shown strain variation in heat lability unrelated to virulence. In nutrient broth, inactivation times at 56°C varied between 5 min and 6 hr. Alexander and Senne [3] described that NDV could survive well in the environment and might persist for months at 8°C and for several days at 37°C. Our experiment was held during the summer to winter seasons, and the last vaccination was administered at the end of September (the outside temperature was around 20°C). So, it is highly possible that the ND vaccine strain could survive and circulate for several months at Farm A, either biotically, namely within the vaccinated ostriches, or abiotically, namely in the local environment of Farm A. During vaccinations, vaccinated ostriches could transmit the vaccine virus directly to unvaccinated ostriches. But, 2 ostriches (Tama 1 and Tama 2) were an exception, because they were introduced into this flock 2.5 months after the last vaccination took place. These results are consistent with a report by Verwoerd [17], who observed that the viremic period in vaccinated slaughter ostriches is 9–11 days and that there are no indications of a carrier state or presence of the virus in the body tissues after this period. Verwoerd et al. [19] reported that NDV in the ostrich could only be back-isolated up to day 9 post infection. Their data are consistent with data from our chicken experiment in that the virus could not be isolated from vaccinated birds 2 weeks post vaccination (data not shown) but are inconsistent with our findings concerning ostriches. Elsewhere, though, it was observed that gallinaceous birds could excrete APMV-1 for only 1–2 weeks but that psittacine birds often shed the virus for several months [16], a finding that supports a possible prolonged period of virus biotic retention.

In conclusion, our study shows the strategies of ND vaccination in commercial ostrich farms with a live vaccine for chickens by eye drop and spray. Both vaccinating techniques are effective for stimulating immunity and maintaining the antibody level for at least 4 months after the last vaccination. The live vaccine virus could be shed from vaccinated ostriches and then be contracted by unvaccinated ones; however, all birds should be captured and vaccinated on a given farm. The spraying method would be easy for farmers. Several groups recommended routine vaccination of ostriches with standard poultry vaccines using a combination of live and killed vaccines [5–7]. Allwright [4] reported that some reactions occurred at the injection site after vaccination with an oil-based vaccine. Because intramuscular and subcutaneous injection with inactivated vaccine is very laborious and dangerous, a booster by eye drop may be useful for labor saving and safety [11, 12]. These observations, particularly in conjunction with the findings of the present study, may be considerably helpful in forming an optimal strategy for ostrich vaccination procedures in Japan, in terms of both effectiveness and convenience. Further trials on a larger scale would likely be helpful in this endeavor.

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