

Recent outbreaks of avian influenza in Japan

K. Sugiura⁽¹⁾, M. Yamamoto⁽²⁾, T. Nishida⁽²⁾, D. Tsukamoto⁽²⁾,
T. Saito⁽³⁾ & T. Onodera⁽⁴⁾

(1) Food and Agricultural Materials Inspection Centre, 2-1 Shintoshin, Chuo-ku, Saitama-shi, Saitama 330-9731, Japan

(2) Animal Health Division, Ministry of Agriculture, Forestry and Fisheries, 1-2-1 Chiyoda-ku, Tokyo 100-7850, Japan

(3) National Institute of Animal Health, 3-1-5 Kannondai, Tsukuba-shi, Ibaraki-ken 305-0856, Japan

(4) Department of Molecular Immunology, University of Tokyo, Bunkyo-ku, Tokyo 113-8657, Japan

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Summary

Recently Japan had three outbreaks of avian influenza (AI) in 2004, 2005 and 2007. An outbreak of highly pathogenic avian influenza (HPAI) was recorded in early 2004, the first for 79 years, with four farms being infected with HPAI virus subtype H5N1. In 2005, 41 farms were found to be infected with AI virus subtype H5N2. In early 2007, four farms were infected with HPAI virus subtype H5N1 again. In all of these outbreaks, the disease was eradicated without resorting to vaccination, through a campaign of culling, movement control of chickens in areas around infected premises, and intensive clinical and serological surveillance. This paper describes the nature of the outbreaks, the eradication measures implemented, clinical and serological surveillance techniques used, and the possible sources of infection.

Keywords

Eradication – Exotic disease – Highly pathogenic avian influenza – Japan – Surveillance.

Introduction

The poultry industry is an important sector in Japan, producing a gross national product of approximately 561 million yen (1 million yen = approx. US\$11,000), 7.9% of the total agricultural product (in 2006) (6, 8). There are 3,460 layer farms and 2,583 broiler farms keeping 183,224,000 layers and 105,287,000 broilers, respectively. Kanto and Kyushu regions are the leading layer and broiler farming areas, respectively (5).

The geographic advantage of being surrounded by sea, and strict import controls on animals and animal products from countries with exotic disease, had protected Japan from the introduction of major exotic diseases for many years. Japan had been free from highly pathogenic avian influenza (HPAI) since 1925 until an outbreak was diagnosed in 2004. As a result of the policy of non-vaccination against avian influenza (AI) that Japan has adopted, the national poultry population is highly susceptible to the disease.

In accordance with the Domestic Animal Infectious Diseases Control Law and the HPAI eradication guidelines (9), the eradication measures that should be taken in the event of an HPAI outbreak are based on the following principles:

- immediate depopulation of infected farms
- movement controls on chickens and other poultry within a radius of 30 km around the infected farms
- intensive surveillance of farms in the movement control areas and on farms epidemiologically related to the infected farms.

Most of these measures are implemented by prefecture veterinary inspectors (veterinarians), with the support of volunteers (farmers, veterinarians, etc.) trained to assist them and private veterinarians, under the guidance and instructions of the Ministry of Agriculture, Forestry and Fisheries (MAFF). There are 175 prefecture Livestock Hygiene Service Centres (LHSCs) located across Japan,

which are responsible for taking samples or making a preliminary diagnosis of an exotic disease. Confirmatory diagnosis of exotic diseases is made by the National Institute of Animal Health (NIAH).

This paper describes the details of the outbreaks of AI recorded in Japan in 2004, 2005 and 2007.

Outbreaks of highly pathogenic avian influenza in 2004

Details of the outbreaks

The four infected farms were named A, B, C and D. Information concerning the location of the four farms, the number of susceptible birds kept on the farms, and the date of diagnosis is presented in Table I. The map in Figure 1 indicates the location of these infected farms.

Farm A

A poultry layer farmer in Yamaguchi prefecture found dead chickens on his farm on 28 December 2003 and reported his observation to an LHSC two days later. A veterinary inspector of the LHSC visited the farm and took samples for virus isolation on 9 January 2004. A virus with haemagglutination activity was isolated and sent to the NIAH on 11 January for subtype identification. The virus was confirmed as subtype H5 on 12 January. The virus was identified to be an N1 subtype using the conventional neuraminidase inhibition (NI) assay. The virus was found to be highly pathogenic using the World Organisation for Animal Health (OIE) standard procedure (12).

Farm B

Three bantams in a backyard flock in Oita prefecture died on 14 February, and samples from the dead bantams were

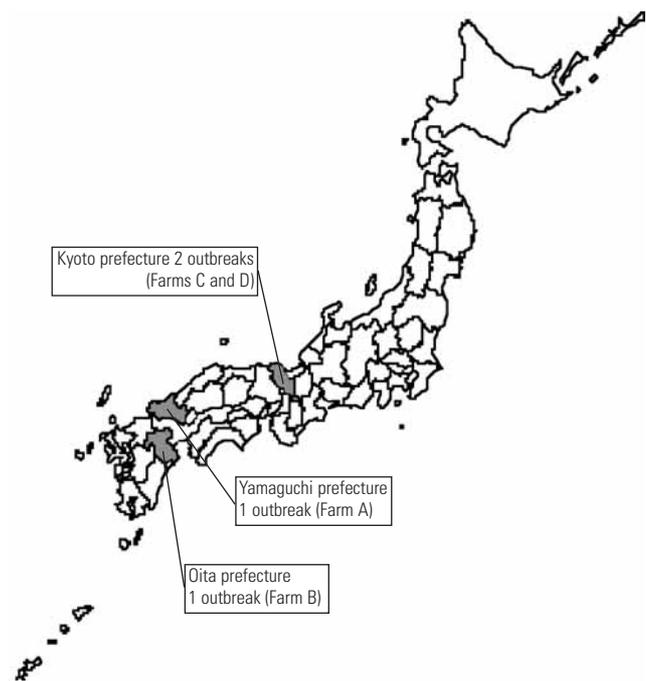


Fig. 1
Location of highly pathogenic avian influenza outbreaks in Japan in 2004

taken by a prefecture inspector on the same day. On 17 February, samples were also sent to the NIAH, where an AI virus subtype H5N1 was identified.

Farm C

A layer farmer in Kyoto prefecture observed high mortality in chickens on 17 February and reported the mortality to an LHSC on 27 February. An inspector of the LHSC visited the farm that day and took samples, which were sent to the NIAH. The NIAH identified an AI virus subtype H5 on 29 February.

Table I

Location, number of birds, clinical signs and results of laboratory investigations of highly pathogenic avian influenza outbreaks in Japan in 2004

Outbreak	Location	Number of susceptible birds	Number of birds affected	Date of diagnosis	Stamping out completed	Number of birds destroyed	Movement controls on area applied	Clinical signs	Laboratory verification
A	Ato town, Yamaguchi prefecture	34,640 layer chickens	28,660	12 January	21 January	34,640	12 January to 18 February	High mortality	Subtype H5N1 (virus isolation)
B	Kokonoe town, Oita prefecture	13 bantams and 1 duck	14	17 February	18 February	14	17 February to 10 March	High mortality	Subtype H5N1 (virus isolation)
C	Tamba town, Kyoto prefecture	225,000 layer chickens	123,003	29 February	22 March	225,000	22 March to 12 April	High mortality	Subtype H5N1 (virus isolation)
D	Tamba town, Kyoto prefecture	15,000 broiler chickens	14,699	3 March	11 March	15,000	22 March to 12 April	High mortality	Subtype H5N1 (virus isolation)

Note: In addition to the above four outbreaks, 6,880 chickens which were shipped from Farm C were destroyed at a poultry processing plant in Hyogo prefecture

Farm D

Increased mortality was observed on a broiler farm 4 km north-east of Farm C on 5 March. An AI virus subtype H5N1 was detected on 8 March.

Control measures implemented

Depopulation of infected farms

Immediately after diagnosis of HPAI, all chickens kept on the four infected farms were destroyed. Depopulation was followed by cleaning and disinfection of the chicken houses. Depopulation and disinfection of the four infected farms were completed by 21 January, 18 February, 22 March and 11 March, respectively. A total of 274,654 chickens were destroyed.

Movement controls

Farm A was quarantined on 9 January 2004 and on 12 January a movement control area with a radius of 30 km was established around the farm. In this area, the movement of poultry and all goods that had the potential to spread the disease was prohibited. The movement control was lifted on 18 February, when 21 days had elapsed after the completion of cleaning and disinfection. By this time the Yamaguchi prefecture government had completed all clinical and serological surveillance activities on all chicken farms in the movement control area, with negative results. Likewise, a movement control area, with a radius of 30 km, was established around Farm B on 17 February, but it was reduced to a radius of 5 km on 28 February and restrictions were lifted on 10 March. A movement control area, with a radius of 30 km, was established around Farm C on 29 February, reduced to a radius of 5 km on 1 April and lifted on 12 April. Farm D was geographically close to Farm C so there was no need to re-establish the movement control area for Farm D.

Surveillance

All chicken farms in the movement control areas were visited by prefecture veterinary inspectors for clinical surveillance. All commercial chicken farms and some hobby chicken farms in the movement control areas were subjected to sampling for serological examination and virus isolation; neither AI antibody nor virus was detected. Faecal samples from wild birds and water samples from ponds and lakes in the movement control areas were also subjected to virus isolation attempts; no AI virus was isolated.

Source of infection

An epidemiological study team formed by the MAFF concluded that the AI virus was probably introduced into

Japan by migratory birds from East Asia (2). The fact that there was a slight difference in the Yamaguchi, Oita and Kyoto prefectures suggested that the viruses were introduced into these prefectures on separate occasions from East Asia.

Economic losses

Compensation to farmers for the depopulation of chickens on the four infected farms totalled 380 million yen; this included cleaning and disinfection costs. In addition, 830 million yen was paid to the farmers located in the movement control areas to compensate them for their losses. A total of 3.2 million doses of AI vaccine were imported for emergency use. Consumption of poultry and eggs declined, which may have been due to reports that products from infected farms in Kyoto had been marketed. However, consumption returned to normal within a short period of time after the Food Safety Commission, an independent scientific agency, issued a fact sheet stating that HPAI was not a food-borne-disease (1).

Outbreaks of avian influenza in 2005

Details of the outbreaks

From April 2005, a layer farmer in Ibaraki prefecture observed reduced egg production and increased mortality in one of his flocks. On 24 June, a type A-like influenza virus was isolated as a result of an examination conducted by a private laboratory. The isolated virus was confirmed to be an influenza virus subtype H5N2 by the NIAH on 26 June.

As a result of the surveillance conducted in and around the movement control areas and on the farms epidemiologically related to the infected premises, and the nationwide surveillance conducted from 8 July, an additional 39 layer farms in Ibaraki prefecture and one layer farm in Saitama prefecture were found to be infected. An AI virus subtype H5N2 was isolated from seven of these farms. The other 33 infected farms were detected as a result of serological examinations only. No clinical signs compatible with AI were observed on any of these infected farms. The pathogenicity test conducted by the NIAH showed that the isolated virus was of low pathogenicity. Eight 7-week-old chicks were inoculated with the infective allantoic fluid, in accordance with the OIE standard procedure (12). Ten days after inoculation all eight chicks were still alive. Figure 2 shows the location of the infected farms.

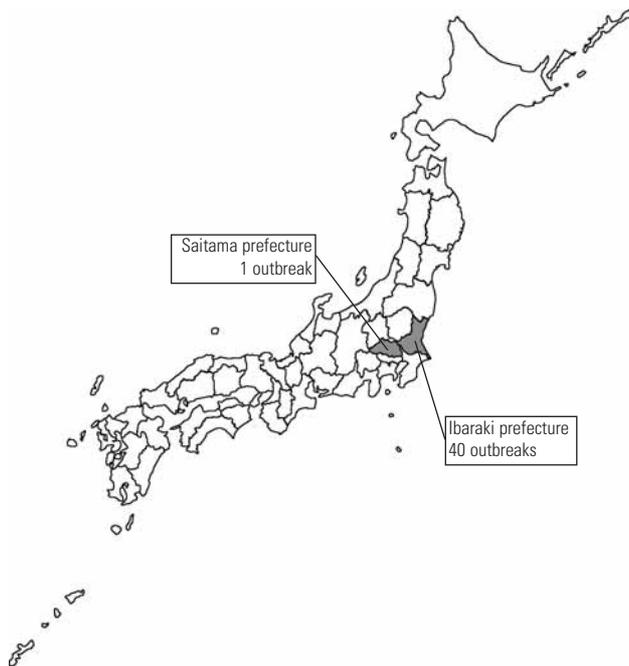


Fig. 2
Location of avian influenza outbreaks in Japan in 2005

Control measures implemented

Depopulation of infected farms

All infected farms were subjected to depopulation except for nine farms which were subjected to the 'Farm under quarantine programme' (Fig. 3). Those nine farms, which were serologically positive only, were considered to have a lower risk of disseminating the virus because they had windowless chicken houses and were manageable on a house-to-house basis. An AI virus was isolated from one of these farms, two months after it was subjected to the 'Farm under quarantine programme'. This farm was subjected to depopulation immediately after the virus isolation.

Depopulation and disinfection of the infected farms were completed by 21 April 2006. A total of 3.36 million chickens were destroyed and 2.42 million chickens were voluntarily culled.

Movement controls

A movement control area of 5 km radius was established around each infected farm immediately after the infection was confirmed. After cleaning and disinfection were completed the control area remained in place for 21 days.

Surveillance

All chicken farms in the movement control areas were visited by prefecture veterinary inspectors for clinical surveillance. All commercial chicken farms in the movement control areas and epidemiologically related

farms were subjected to sampling for serological examination and virus isolation.

Nationwide surveillance was also conducted from 8 July until 16 September to confirm how extensively the disease was spreading in Japan (3). Over 60% of layer farms keeping more than 1,000 chickens in Ibaraki and its adjacent prefectures (Fukushima, Tochigi, Gunma, Saitama and Chiba prefectures) and 30% of layer farms keeping more than 1,000 chickens in the rest of Japan were randomly selected and subjected to sampling for serological examination, using the agar-gel immunoprecipitation test. Of a total of 2,409 farms which were subjected to this surveillance, 23 were found to be infected (22 farms in Ibaraki prefecture and one farm in Saitama prefecture).

In addition, faecal samples from wild birds and water samples from ponds and lakes in 20 cities and towns in Ibaraki prefecture were subjected to virus isolation attempts; no AI virus was isolated.

Source of infection

An epidemiological study team formed by the MAFF could not rule out the possibility that a virus or vaccine was illegally introduced into Japan from Central America (4). The isolated virus (*A/chicken/Ibaraki/1/2005*, GenBank accession No. AB261853) was subtype H5N2 and similar to a virus isolated in Guatemala in 2002 (*A/chicken/Guatemala/45511-3/00*, GenBank accession No. AY497090). There are no migratory birds that are known to migrate from Central America to Japan directly or through Alaska. In addition, an experiment conducted later revealed that chickens were highly susceptible but ducks were not susceptible to the virus isolated from the infected farms, indicating that the virus was not replicating in wild birds.

Economic losses

Compensation to farmers for the depopulation of chickens totalled 1,305 million yen. In addition, the cleaning and disinfection of the infected premises and the destruction of infected chickens cost 1,018 million yen. A further 143 million yen was paid to the farmers located in the movement control areas to compensate them for their losses arising from delayed shipment of eggs and chickens.

A mutual assistance fund had been voluntarily established following the outbreak in 2004, from which 1,480 million yen was paid to those affected farmers who restocked their chicken houses after they were cleaned and disinfected.

During the outbreaks, no big decline of chicken and egg consumption was observed. Information was repeatedly

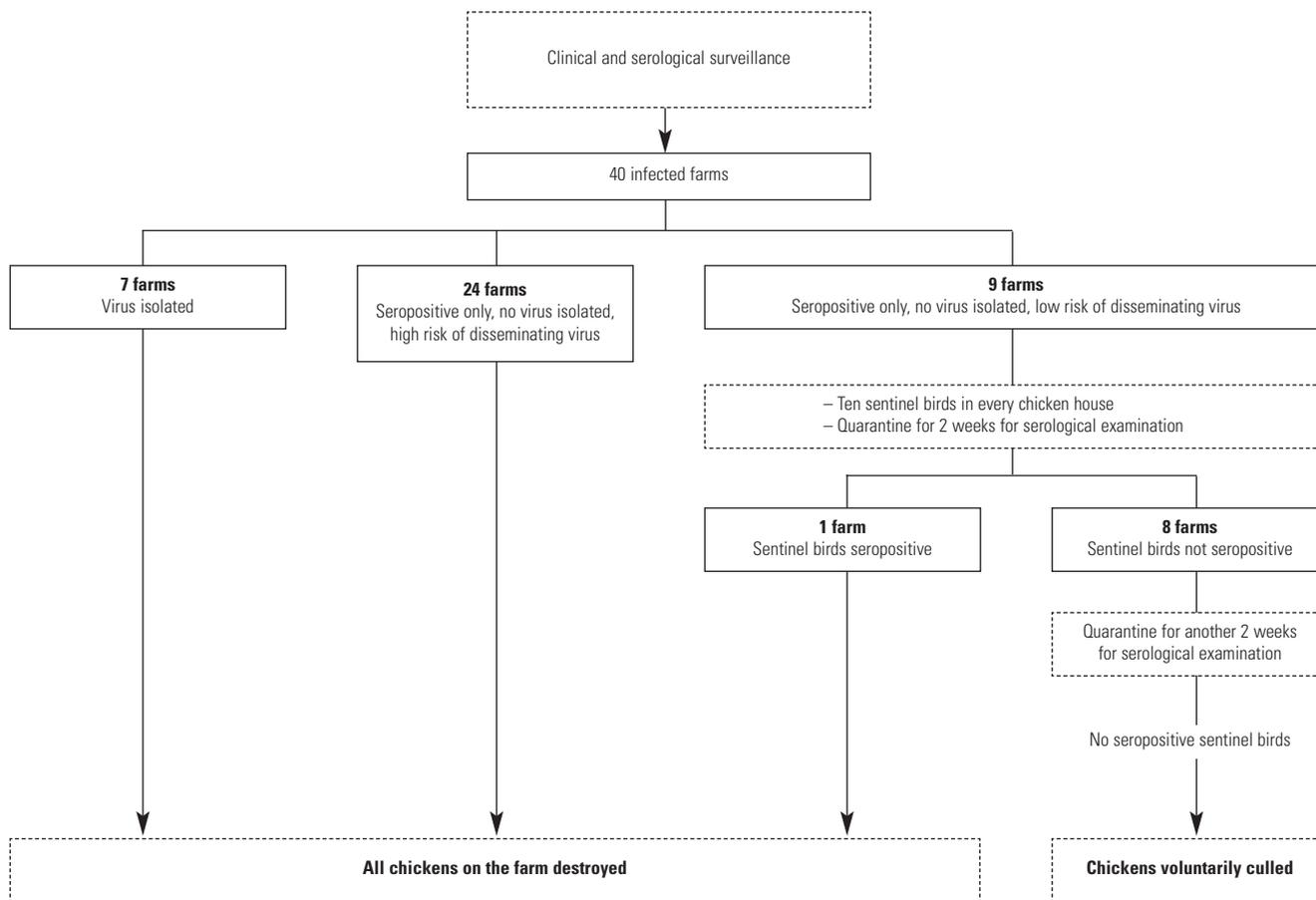


Fig. 3
Chart outlining the measures taken on the avian influenza-infected farms in Ibaraki and Saitama prefectures in 2005

After the initial case was detected in June a further 40 farms were found to be infected. The virus was isolated on seven of these farms only; on the other 33 farms infection was detected using serological methods. Nine of the farms that were serologically positive only had windowless chicken houses and therefore had a lower risk of disseminating the virus. These nine farms were subjected to the ‘Farm under quarantine programme’

provided stating that AI is not a food-borne disease, and officials of the MAFF regional offices visited shops and supermarkets to ensure that chicken and eggs were properly labelled.

Outbreaks of highly pathogenic avian influenza in 2007

In January and February 2007, four farms were found to be infected with HPAI virus subtype H5N1: one broiler breeding farm, one broiler farm and one layer farm in Miyazaki prefecture and one layer farm in Okayama prefecture. The disease was eradicated by stamping out the infected farms without resorting to vaccination.

Details of the outbreaks

The four infected farms were named A, B, C and D. Information concerning the location of the four farms, the

number of susceptible birds kept on the farms, and the date of diagnosis is presented in Table II. The map in Figure 4 indicates the location of these infected farms.

Farm A

In early January 2007, a broiler breeding farmer in Miyazaki prefecture observed increased mortality and swollen faces in one of his flocks. By 13 January, 3,800 birds of his 12,000 bird flock were dead. A veterinary inspector of the LHSC visited the farm and took samples for virus isolation on 11 January. A virus with haemagglutination activity was isolated and sent to the NIAH on 12 January for subtype identification. The virus was confirmed as subtype H5 on 13 January. The virus was identified to be an N1 subtype using the conventional NI assay. The virus was found to be highly pathogenic using the OIE standard procedure (12).

Farm B

On 22 January, a broiler farmer keeping 53,000 birds in Miyazaki prefecture noticed increased mortality in one of

Table II
Location, number of birds, clinical signs and results of laboratory investigations of highly pathogenic avian influenza outbreaks in Japan in 2007

Outbreak	Location	Number of susceptible birds	Number of birds affected	Date of diagnosis	Stamping out completed on	Number of birds destroyed	Movement control area applied	Clinical signs	Laboratory verification
A	Kiyotake town, Miyazaki prefecture	12,000 broiler breeding chickens	3,675	13 January	16 January to 6 February	8,325	13 January	High mortality	Subtype H5N1 (virus isolation)
B	Hyuga city, Miyazaki prefecture	52,500 broiler chickens	4,611	25 January	28 January to 20 February	47,889	25 January	High mortality	Subtype H5N1 (virus isolation)
C	Takahashi city, Okayama prefecture	12,000 layer chickens	761	29 January	7 February to 28 February	11,239	29 January	High mortality	Subtype H5N1 (virus isolation)
D	Shintomi town, Miyazaki prefecture	93,000 layer chickens	2,498	1 February	5 February to 28 February	90,502	5 February	High mortality	Subtype H5N1 (virus isolation)

Note: In addition to the above, a farm adjacent to Farm B keeping 51,905 broiler chickens also applied stamping out. Furthermore, avian influenza virus subtype H5N1 was isolated from a wild bird (hawk-eagle) found dead in Kumamoto prefecture on 23 February

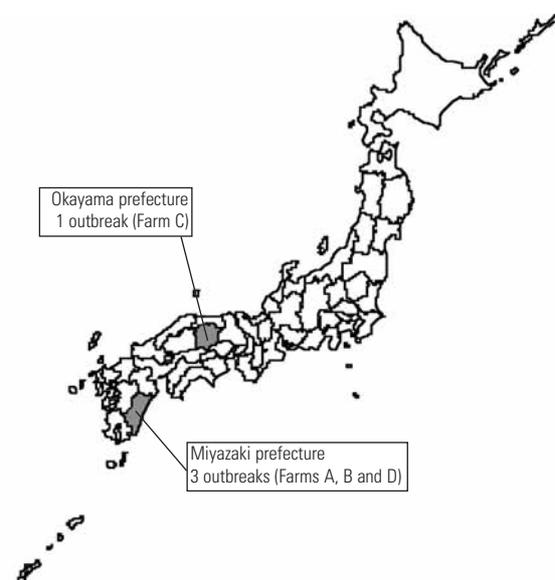


Fig. 4
Location of highly pathogenic avian influenza outbreaks in Japan in 2007

his flocks and reported his observation to his veterinarian. An inspector from the LHSC visited the farm and took samples for diagnosis on 23 January when the mortality rose to 326 birds. The mortality rose to 1,300 by 24 January. On 25 January, AI virus subtype H5 was isolated by the NIAH.

Farm C

On 22 January, a layer farmer in Okayama prefecture found two dead birds in a cage. On 27 January the farmer reported the increased mortality to the LHSC and an inspector of the LHSC visited the farm and took samples, which were subjected to a preliminary test with positive results. An AI virus subtype H5 was isolated on 29 January.

Farm D

On a layer farm in Miyazaki prefecture increased mortality was observed on 30 January. The dead birds had cyanosed combs. A virus with haemagglutination activity was isolated by the LHSC, which was later identified to be H5 subtype by the NIAH on 1 February.

Control measures implemented

Depopulation of infected farms

Immediately after diagnosis of HPAI, all chickens kept on the four infected farms were destroyed. Including the chickens on a farm adjacent to Farm B, a total of 221,905 chickens were destroyed.

Movement controls

Farm A was quarantined on 11 January 2007. On 13 January, a movement control area, with a radius of 10 km, was established around Farm A. The movement control was lifted on 7 February, by which time the Miyazaki prefecture government had completed all clinical and serological surveillance activities on all chicken farms and hobby chicken farms in the movement control area, with negative results. Likewise, movement control areas were established around Farms B, C and D from 25 January to 20 February, from 29 January to 28 February, and from 1 February to 28 February, respectively.

Surveillance

All chicken farms in the movement control areas were visited by prefecture veterinary inspectors for clinical surveillance twice with an interval of ten days. All commercial chicken farms and some hobby chicken farms in the movement control areas were subjected to sampling for serological examination and virus isolation; neither AI antibody nor virus was detected. Faecal samples from wild birds and water samples from ponds and lakes

in the movement control areas were also subjected to virus isolation attempts; no AI virus was isolated.

Source of infection

An epidemiological study team formed by the MAFF concluded that the AI virus was probably introduced into Japan by migratory birds from East Asia (7). No AI virus was isolated from a migratory bird, but following extensive surveillance targeting wild birds, a virus subtype H5N1

was isolated from a mountain hawk-eagle found dead in Kumamoto prefecture. The fact that the viruses isolated from the infected farms and the hawk-eagle were genetically similar to those viruses isolated in Mongolia, the Republic of Korea and the People's Republic of China in recent years (and not similar to the virus isolated from the 2004 outbreaks in Japan) suggested that the viruses were introduced into Miyazaki, Okayama and Kumamoto prefectures from these countries. Figure 5 shows a comparison of the haemagglutinin gene sequence of

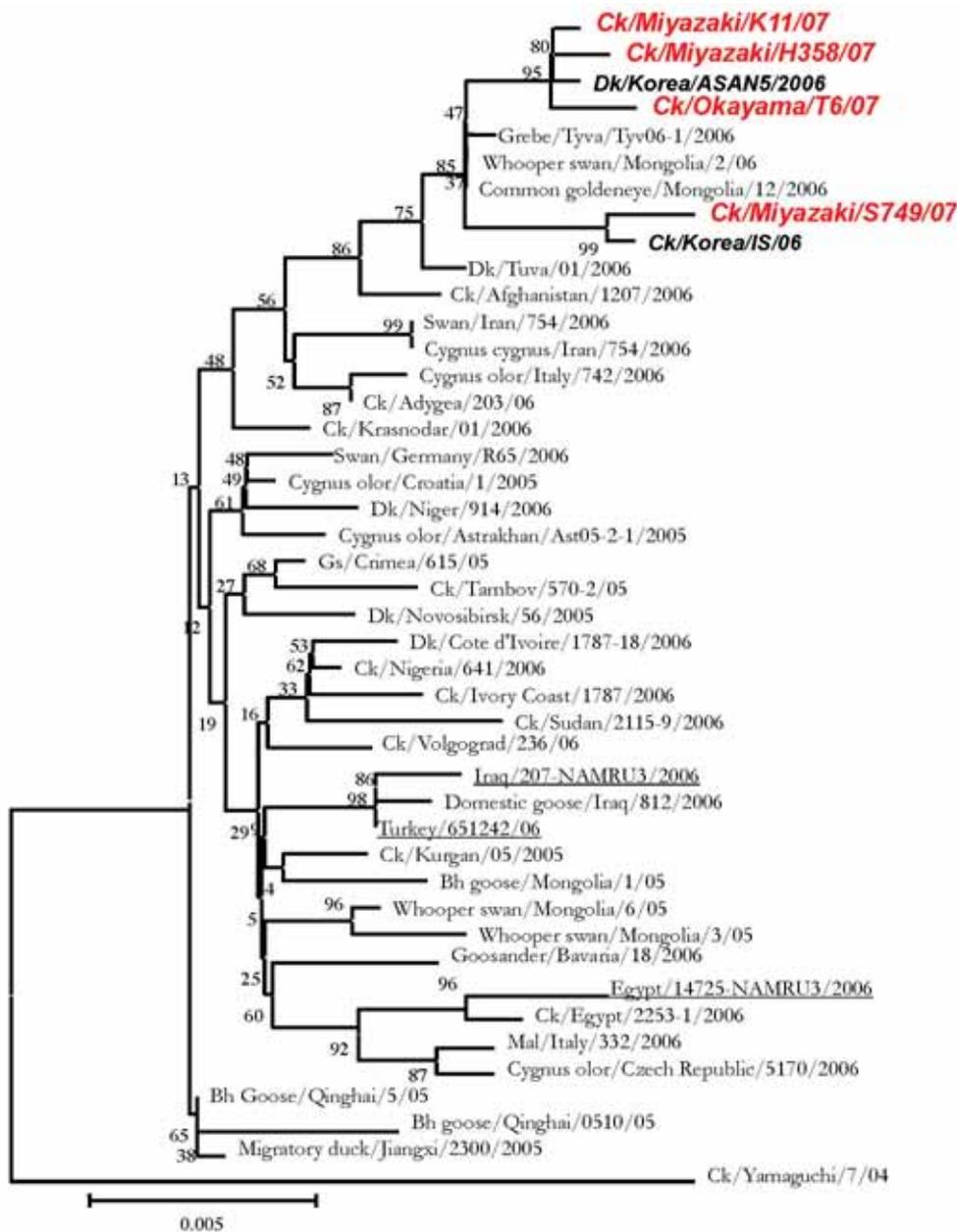


Fig. 5

A phylogenetic tree created using the neighbour-joining method based on haemagglutinin gene base sequence

The numbers at the nodes indicate confidence levels of bootstrap analysis with 1,000 replications as a percentage value. Strains isolated in humans are underlined. Ck/Yamaguchi/7/04 is not included in the Qinghai Lake-related strains

The sequence data of the Miyazaki and Okayama isolates were obtained from Dr Masaji Mase, National Institute of Animal Health, Japan, and the sequence data of the Korean isolates were obtained from Dr Youn-Jeong Lee, National Veterinary Research and Quarantine Service, Korea

viruses isolated from various outbreaks including the four outbreaks in 2007 in Japan.

Economic losses

Compensation paid to farmers for the depopulation of 210,000 chickens totalled 106 million yen. The cleaning and disinfection of the infected premises and the destruction of infected chickens cost 1,018 million yen. In addition, 176 million yen was paid to the farmers located in the movement control areas to compensate them for their losses.

Fifty-seven million yen was paid from the mutual assistance fund to those farmers who restocked their chicken houses after they were cleaned and disinfected.

During the outbreaks, information was repeatedly provided stating that HPAI was not a food-borne disease and seeing that activities were conducted to ensure proper labelling of chicken products. As a result, there was no significant decline in chicken and egg consumption.

Conclusion

The outbreaks of HPAI in 2004 and 2007 were successfully eradicated in a relatively short time. In contrast, it took ten months to eradicate the outbreaks in 2005, because the infected birds did not develop clinical signs of AI and by the time the first infected farm had been detected the disease was already widespread. Early detection of the disease and early reaction to the disease outbreaks were the key to the successful eradication of the disease. The fact that all AI viruses of subtype H5 and H7 are not highly

pathogenic indicates that surveillance for the early detection of the disease should not only depend on clinical signs but also on serological examination.

After the outbreak of LPAI in 2005, all farms keeping more than 1,000 birds were subjected to monitoring by an LHSC every year. After the outbreak of AI in Korea in 2007 this number was lowered and farms with as few as 100 birds were tested. In addition, the target species were expanded to include ducks, quail and turkeys. The monitoring included clinical examination of the flocks and antibody testing of serum samples from ten randomly selected birds. As a result of this surveillance, three quail farms in Aichi prefecture were found to be infected with LPAI virus subtype H7N6 in March 2009.

In addition to the surveillance targeting poultry farms, surveillance targeting wild birds was initiated in October 2008, following detection of HPAI viruses from whooper swans (*Cygnus cygnus*) in northern Japan early in that year (10, 11). The surveillance included collection of faecal samples from wild geese, ducks and swans; trapping of wild birds for collection of oral swabs; and collection of dead birds for collection of swab samples. The swab samples were subjected to isolation of AI virus.

The epidemiological investigations conducted following the 2004 and 2007 outbreaks indicated that these outbreaks were not epidemiologically related and that migratory birds were the most probable source of infection. This indicates that being surrounded by sea no longer provides Japan with effective protection from the introduction of AI, in particular when the disease is epidemic/endemic in neighbouring countries. ■

Les foyers d'influenza aviaire survenus récemment au Japon

K. Sugiura, M. Yamamoto, T. Nishida, D. Tsukamoto, T. Saito & T. Onodera

Résumé

Trois foyers d'influenza aviaire ont été signalés au Japon récemment, survenus respectivement en 2004, 2005 et 2007. Le foyer d'influenza aviaire hautement pathogène (IAHP) enregistré début 2004 était le premier depuis 79 ans ; l'infection était due au sous-type H5N1 du virus de l'IAHP et a affecté quatre exploitations. En 2005, 41 exploitations ont été touchées par le sous-type H5N2 du virus de l'influenza aviaire. Début 2007, quatre exploitations ont été affectées ; l'infection était due, une nouvelle fois, au sous-type H5N1 du virus de l'IAHP. Dans chacun de ces foyers, la maladie a été éradiquée sans recourir à la vaccination ; la campagne d'abattage sanitaire mise en place a été associée au contrôle des déplacements de poulets dans les zones entourant les exploitations affectées et à l'exercice d'une surveillance clinique et sérologique intensive. Les auteurs décrivent les caractéristiques des foyers, les mesures d'éradication

mises en œuvre, les techniques de surveillance clinique et sérologique utilisées ainsi que les origines possibles de l'infection.

Mots-clés

Éradication – Influenza aviaire hautement pathogène – Japon – Maladie exotique – Surveillance.



Focos recientes de influenza aviar en Japón

K. Sugiura, M. Yamamoto, T. Nishida, D. Tsukamoto, T. Saito & T. Onodera

Resumen

En 2004, 2005 y 2007 se produjeron tres brotes de influenza aviar en Japón. A inicios de 2004, el primer foco del subtipo H5N1 del virus de la influenza aviar altamente patógena registrado en los últimos 79 años infectó cuatro explotaciones. En 2005, el subtipo H5N2 de la influenza aviar afectó 41 granjas avícolas. Por último, el subtipo H5N1 de la influenza aviar altamente patógena volvió a infectar cuatro explotaciones a principios de 2007. En los tres casos, la enfermedad se erradicó mediante una campaña de sacrificio sistemático, el control de movimientos de aves en torno a los criaderos infectados y una vigilancia clínica y serológica intensiva, pero sin recurrir a la vacunación. En este artículo se describen las características de los brotes; las medidas de erradicación y las técnicas de vigilancia clínica y serológica aplicadas, así como las posibles fuentes de infección.

Palabras clave

Enfermedad exótica – Erradicación – Influenza aviar altamente patógena – Japón – Vigilancia.



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