Spread of Aujeszky’s disease among wild boars and domestic pigs in Ukraine


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Introduction

Aujeszky’s disease, also known as pseudorabies, is an acute infectious viral disease in a variety of mammals caused by Suid herpesvirus 1, a member of the subfamily Alphaherpesvirinae and the family Herpesviridae. This virus causes significant economic losses in agriculture of numerous countries. In particular, in pig farming, the main losses are currently associated with restrictions of international trade, as well as the cost of vaccination or slaughter of infected animals. The main reservoirs of this disease are considered to be wild boars and domestic pigs. So, in this article the authors performed a comparative retrospective analysis of the prevalence of Aujeszky’s disease among these species in Ukraine over 2009–2020 by systematizing and analyzing the epizootic data and results of serological studies. As a result of the conducted research, there is a clear trend that shows the reduction in the number of locations in Ukraine (farms, households, etc.) with domestic pigs affected by Aujeszky’s disease. Thus, in 2009 four such farms were found, and in 2018 – only one. During 2014–2016 and 2019–2020, affected farms and locations were not registered for this disease. In total, 21 such points with infected pigs were registered during the analyzed period. As for wild boars, during the analyzed 12 years, locations with animals affected by Aujeszky’s disease were registered only in 2013 and 2014 (two and one, respectively). It should be noted that all of those with infected wild boars were found in the AR Crimea. For the twelve years, the number of tested sera samples from domestic pigs amounted to 378,678 (7.4% were positive) and from wild boars – 9,052 (19.8% were positive). As a result of comparative geographical analysis of the obtained data on the detection of specific humoral antibodies to the Aujeszky’s disease virus among both species for 12 years in the regions of Ukraine, there is no established clear correlation between the spread of the disease among wild boars and domestic pigs. Thus, the highest seroprevalence rates among wild boars were observed in the northern and northeastern parts of Ukraine, and in domestic pigs, on the contrary, in the southern and central parts of this country. It should be noted, that since 2014 the number of serological tests among both species for carriers of Aujeszky’s disease has significantly decreased.

Keywords: Pseudorabies; Suid herpesvirus 1; PRV; epizootic process; serological studies; Sus scrofa; swine.

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Wild boars, like domestic pigs, can be sources and reservoirs of the SHV-1 pathogen, and it is detected in this species in those countries where eradication of Aujeszky’s disease has already been carried out among domestic pigs (Corn et al., 2004; Vengust et al., 2005; Lari et al., 2006; Mahmoud et al., 2011). Wild boars seropsitive to Aujeszky’s disease virus were detected in the 98 districts of the United States, the overall prevalence was 27.7% of the total number of animals examined (in 4,293 animals from 15,494) (Pedersen et al., 2013). In many European countries, pseudorabies among dogs is constantly registered after they are fed with meat and offal from killed wild boars (Cano-Terriza et al., 2019; Ciarello et al., 2022). Studies have shown that Aujeszky’s disease virus is secreted from the genitals of wild boars and can be transmitted during mating (Charrier et al., 2018). However, as early as 1997, it was shown that although Sus scrofa can be a reservoir of the Aujeszky’s disease virus in the natural environment and can transmit it transplacentally, by contact or alimentary means (cannibalism), they are carriers of highly attenuated strains (Halim et al., 1997).

It is possible to isolate a PRV from the pathological material on transplanted cultures of cells of pig’s origin. Its antigen is detected by immunoperoxidase or immunofluorescent staining, in the neutralization reaction with specific sera or monoclonal antibodies (OIE, 2018). According to the recommendations of the World Organization for Animal Health, polymerase chain reaction (PCR) can be used to confirm the presence of the virus in the material. Developed PCR kits allow vaccine viruses to be differentiated from field ones (DIVA-strategy) (Cheng et al., 2021). Also, the enzyme-linked immunosorbent assay (ELISA) is widely used to confirm the presence of antibodies to the PRV. ELISA with DIVA-strategy capabilities has also been developed (Ai et al., 2018; Silva-Junior et al., 2020).

Marker vaccines, represented by vaccines with natural or artificial genetic deletions in DNA, play an important role in the measures to combat Aujeszky’s disease (Freuling et al., 2017; Colomer et al., 2022). The virus used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1). Such vaccines have advantages over the ones used to prepare these vaccines doesn’t include a specific glycoprotein, such as the glycoprotein gE (g1).

These kits are discriminatory in that they distinguish between infected and latently infected animals among vaccinated swine by using the marker gE-negative vaccine against Aujeszky’s disease.

Seroprevalence for each oblast was calculated as the number of positive samples divided by the sample quantity in oblast. Calculating bimodal confidence intervals (BCI) was conducted by using the method Clopper-Pearson exact with confidence level – 0.95 and was performed for seroprevalence estimates using the R epitools package (Ausvet, version 2020, Australia) (https://epitools.ausvet.com.au). That website is free and it is intended for use by epidemiologists and researchers involved in estimating disease prevalence or demonstrating freedom from disease through structured surveys, or in other epidemiological applications. Information about the total number of locations / farms affected by Aujeszky’s disease was obtained from the State Statistics Service of Ukraine (http://ukrstat.gov.ua).

Positive incidences by oblast were mapped in the software Quantum GIS 3.16.0 (International Quantum GIS Project, version 2020, Germany), which is free on the website (www.qgis.org/ru/site/forusers/download.html). The vector layers for the borders of Ukraine’s regions were downloaded from the site www.diva-gis.org/data. Quantile classification with 5 classes of the data was chosen. With this classification, an equal number of oblasts fall into each class.

Data is presented in the article without taking into account the occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and part of the temporarily occupied territories of Donetsk and Luhansk regions.

Results
In total, 21 locations (farms, households etc.) affected with Aujeszky’s disease among domestic pigs were registered during the analyzed period in Ukraine. Thus, in 2009 such locations were registered in Vinnytska (1 location), Donetsk (1), and Chernihivskas (2) regions. In 2010, they were
registered in Vinnytska (2 locations) and Donetsksa (1) regions. Over 2011,
four affected locations were found – two in Vinnytska and one each in
Donetsksa and Mykolaivska regions. The following year, there was only
one such location in the Zaporizka region. In 2013, three affected farms
were registered in the AR Crimea. In 2017, a single affected location was
registered in Zaporizka and also Khersonska regions. In 2018, only one
such location was found in Khersonska region. During the period of
2014–2016 and 2019–2020, locations affected with Aujeszky’s disease
were not registered in Ukraine.

For wild boars, during the analyzed period, locations affected with
Aujeszky’s disease were registered only in 2013 and 2014, respectively, two
and one. It should be noted that all of them were found in the AR Crimea.

Regarding serological studies, for the period 2009–2020, 9,052 sera
samples from wild boars were tested for the presence of antibodies to
pseudorabies and 1,788 positive reactions were obtained, which is 19.8% (BCI, 18.9–20.6%) of the studied samples. The generalized and systema-
tized results of blood sera from wild boars studies are presented in Table 1
and Figure 1.

### Table 1

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of tested samples</th>
<th>Number of positive samples</th>
<th>Percentage of responding animals</th>
<th>Binomial confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>1,301</td>
<td>195</td>
<td>15.0</td>
<td>13.09–17.05</td>
</tr>
<tr>
<td>2010</td>
<td>1,214</td>
<td>224</td>
<td>18.5</td>
<td>16.31–20.75</td>
</tr>
<tr>
<td>2011</td>
<td>1,197</td>
<td>36</td>
<td>14.0</td>
<td>10.01–18.86</td>
</tr>
<tr>
<td>2012</td>
<td>1,852</td>
<td>344</td>
<td>18.6</td>
<td>16.63–20.42</td>
</tr>
<tr>
<td>2013</td>
<td>820</td>
<td>178</td>
<td>21.7</td>
<td>18.93–24.69</td>
</tr>
<tr>
<td>2014</td>
<td>1,935</td>
<td>480</td>
<td>24.8</td>
<td>22.90–26.79</td>
</tr>
<tr>
<td>2015</td>
<td>106</td>
<td>49</td>
<td>46.2</td>
<td>36.49–56.18</td>
</tr>
<tr>
<td>2016</td>
<td>2</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>2017</td>
<td>407</td>
<td>51</td>
<td>12.5</td>
<td>9.47–16.14</td>
</tr>
<tr>
<td>2018</td>
<td>912</td>
<td>183</td>
<td>20.1</td>
<td>17.51–22.81</td>
</tr>
<tr>
<td>2019</td>
<td>246</td>
<td>48</td>
<td>19.5</td>
<td>14.75–25.02</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>9,052</td>
<td>1,788</td>
<td>19.8</td>
<td>18.94–20.59</td>
</tr>
</tbody>
</table>

**Fig. 1.** Dynamics of the seroprevalence among wild boars for Aujeszky’s disease virus by years according to the reports of regional laboratories and SSRILDVSE

As shown in Figure 1, seroprevalence among wild boars in Ukraine for the analyzed period was the highest in 2015 – 46.2% (BCI, 36.5–56.2%). The high percentage of positive reactions in this year is due to the fact, that only 106 samples from seven regions of Ukraine were studied and in two of them (Odessa and Poltava) a significant percentage of positive reactions was detected – 72.4% and 65.4% respectively. At the same
time, the lowest rate of this indicator was in 2009, 2011 and 2017 – 15.0% (BCI, 13.1–17.1%), 14.0% (BCI, 10.0–18.9%), and 12.5% (BCI, 9.5–16.1%), respectively. In 2016, sera samples with humoral antibodies to PRV were not detected. This is due to the very low number of samples tested – only two sera samples from the Kherson region were tested du-
ring this year. In 2020, there were no studies regarding seroprevalence of
PRV among wild boars. Overall, from 2009 to 2019, the seroprevalence rate for Aujeszky’s disease virus among this species was about the same, except in 2015.

Blood sera samples for our investigation were selected from all the
regions of Ukraine. For the twelve years period, the largest numbers of
samples were tested in 2012 and 2014 – 1,852 and 1,935 samples, respec-
tively, and the smallest in 2016 – only two samples. Also, a small number of samples were tested in 2015 and 2019 years – 106 and 246 samples, respectively. Data on the scope of serological diagnosis for the detection of
specific humoral antibodies to SHV-1 among wild boars in terms of
Ukrainian regions are presented in Figure 2.

Systematized data indicate that the monitoring investigation covered
all regions of Ukraine. During the period 2009–2020, the largest number
of sera samples from this species of animals was studied in seven areas:
Sumrska (769 samples), Polatska (685 samples), Kharkivska (682 sam-
plies), Zhytomyrska (637 samples), Chernihivska (569 samples), Lvivska
(542 samples), and Chernihivska (512 samples) regions. The smallest
number of studies was conducted in the following areas: Zaporizka
(176 samples), Mykolaivska (158 samples), Temopilksa (155 samples),
Dnipropetrovska (149 samples), Kirovohradska (145 samples), Zakar-
patska (119 samples), and Khersonska (77 samples) regions. The results
of serological monitoring among wild boars for the twelve years period
regarding the detection of specific humoral antibodies to the pseudorabies
virus in terms of Ukrainian regions are presented in Figure 3.

**Fig. 2.** Quantity of wild boars’ sera samples tested for Aujeszky’s disease virus in Ukraine over 2009–2020

**Fig. 3.** Cartographic analysis of seroprevalence of wild boars’ for Aujeszky’s disease virus in Ukraine over 2009–2020

In general, the seroprevalence rate for this disease in Ukraine during
the analyzed period ranged from 30.6% (in Sumrska region) to 2.6% (in
Khersonska region). As can be seen from the data shown in Figure 4, the
highest rates were found in five Ukrainian oblasts: Sumska (30.6%),
Kharkivska (30.2%), Chernihivska (28.3%), Zhytomyrska (27.5%), and
Temopilksa (26.5%). Ivano-Frankivska, AR Crimea, Volyska, Myk-
olaivska, Zaporizka, and Khersonska regions had the lowest percentage
of positive-response animals within range of 2.6–7.7%. It should be empha-
sized that the results of the research did not reveal any region of Ukraine where the circulation of Aujeszky’s disease virus in wildlife was not observed.

Regarding serological studies among domestic pigs, in the period from 2009 to 2020, 378,678 sera samples from this species were tested and 27,897 positive reactions were obtained for the presence of antibodies to PRV, which is 7.4% (BCI, 7.2–7.45%) of total studied. The generalized and systematized results of blood sera from swine studies are presented in Table 2 and Figure 4.

### Table 2

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of tested samples</th>
<th>Number of positive samples</th>
<th>Percentage of responding animals</th>
<th>Binomial confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>65,949</td>
<td>8,183</td>
<td>12.4</td>
<td>12.16–12.66</td>
</tr>
<tr>
<td>2010</td>
<td>32,913</td>
<td>2,789</td>
<td>8.5</td>
<td>8.18–8.78</td>
</tr>
<tr>
<td>2011</td>
<td>103,025</td>
<td>7,264</td>
<td>7.1</td>
<td>6.90–7.21</td>
</tr>
<tr>
<td>2012</td>
<td>84,431</td>
<td>5,935</td>
<td>7.0</td>
<td>6.86–7.20</td>
</tr>
<tr>
<td>2013</td>
<td>45,678</td>
<td>2,252</td>
<td>4.9</td>
<td>4.71–5.11</td>
</tr>
<tr>
<td>2014</td>
<td>26,925</td>
<td>1,216</td>
<td>4.5</td>
<td>4.27–4.77</td>
</tr>
<tr>
<td>2015</td>
<td>5,364</td>
<td>55</td>
<td>1.0</td>
<td>0.77–1.33</td>
</tr>
<tr>
<td>2016</td>
<td>2,948</td>
<td>8</td>
<td>0.3</td>
<td>0.12–0.53</td>
</tr>
<tr>
<td>2017</td>
<td>3,209</td>
<td>35</td>
<td>1.1</td>
<td>0.76–1.51</td>
</tr>
<tr>
<td>2018</td>
<td>3,677</td>
<td>152</td>
<td>4.1</td>
<td>3.51–4.83</td>
</tr>
<tr>
<td>2019</td>
<td>1,534</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>2,825</td>
<td>8</td>
<td>0.3</td>
<td>0.12–0.56</td>
</tr>
<tr>
<td>Total</td>
<td>378,678</td>
<td>27,897</td>
<td>7.4</td>
<td>7.2–7.45</td>
</tr>
</tbody>
</table>

Seroprevalence among swine in Ukraine for the analyzed period was the highest in 2009 – 12.4% (BCI, 12.2–12.7%). The lowest rates of this indicator were in 2016 and 2020 – 0.3% (BCI, 0.1–0.5%) and 0.3%; (BCI, 0.1–0.6%), respectively. In 2019, sera samples with humoral antibodies to PRV were not detected. This is due to the very low number of samples tested – 1,534 samples from the four regions were tested during this year. In general, during the analyzed period there is a tendency to significant reduction in the incidence of seropositivity among pigs to the Aujeszky’s disease virus.

Sera samples for the investigation were collected from the all regions of Ukraine. The largest numbers of samples were tested in 2011 and 2012 – 103,025 and 84,431 samples, respectively, and the smallest – in 2019 (only 1,534 samples). It should be noted that during the analyzed period, the volume of serological diagnostic of swine for Aujeszky’s disease decreased significantly – from 103,025 samples in 2011 to 1,534 samples in 2019. The results of serological monitoring among swine for the twelve years period regarding the detection of specific humoral antibodies to pseudorabies virus in terms of Ukrainian regions are presented in Figure 5.

In general, the seroprevalence rate for pseudorabies among domestic pigs in Ukraine during the analyzed period ranged from 28.9% (in Zaporiжka region) to 0.1% (in Odeska region). The highest indicators were found in the five oblasts: Zaporizhia (28.9%), Kheresnska (18.6%), Vinnitska (18.0%), Chernihivska (13.2%), and Zhytomyrska (12.2%) regions. The lowest percentage of positive-response pigs was registered in the following areas: AR Crimea, Sumska, Volyska, Kirovohradska, Kyivska, Mykolaitvska, and Odeska regions (0.1–0.7%). In only one region of Ukraine (Chernavetska region) during the investigation period, were sera samples containing antibodies to Aujeszky’s disease virus not detected.

The systematized results of serological monitoring among wild boars and domestic pigs for the twelve years period regarding the detection of specific humoral antibodies to PRV in terms of Ukrainian regions are presented in Figure 6. In the vast majority of cases, no correlation is observed between the spread of Aujeszky’s disease in wild boars and domestic pigs, with the exception of five areas: Chernihivska, Zhytomyrska, Kharkivska, Kyivska, and Ternopilska regions. According to the results of the territorial spread of Aujeszky’s disease studies among wild boars in Ukraine, it was found that the highest incidence rates among this species are observed in the northern and northeastern parts of our country (Fig. 6). At the same time, on the other hand, the highest seroprevalence rates among domestic pigs are observed in the southern and central parts of Ukraine.

### Discussion

Despite all preventive, diagnostic and therapeutic measures of veterinary specialists, infectious diseases are widespread among animals in all countries of the world and cause significant economic losses to husbandry. In particular, in pig farming, the main costs are currently associated with limitations on international trade, as well as the cost of vaccination or slaughter of infected animals (OEI, 2018). According to the scientific literature, one of the most common diseases among pigs is Aujeszky’s disease (pseudorabies) (Di Marco et al., 2021). PRV remains endemic in Eastern and South-Eastern Europe, Latin America and Asia. Variant strains of this virus continue to circulate among swine in China (Sun et al., 2016). In addition, there is information that about 20.0% of wild boars in the United States are seropositive to this infection. At the same time, the prevalence of pseudorabies among this species in European countries varies up to 60.0% (Lipowski et al., 2017; At et al., 2018; Carr et al., 2018).

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In general, PRV eradication programs include culling infected animals, vaccination by “marker” vaccines, restricting import of pigs, and isolating domestic pigs from wild boars. In most countries such programs are based on using the vaccines with deletion characteristics (“marker” vaccines) (Freuding et al., 2017; Colomer et al., 2020; Mettenleiter, 2020). The detection of infected or latently infected animals in the herds vaccinated by a gE-negative vaccine is performed by using the discriminant ELISA kits that specifically detect antibodies to PRV gE glycoprotein. If antibodies to PRV gE glycoprotein are detected in the serum of pigs vaccinated by the gE-negative vaccine, they are considered infected (Ai et al., 2018; Silva-Junior et al., 2020). gE-ELISA is almost as sensitive as screening ELISA and significantly exceeds the virus-neutralization reaction (OIE, 2018). Such ELISA kits give opportunity to identify not only infected but also latently infected animals (Silva-Junior et al., 2020). Thus, Aujeszky’s disease eradication programs are based on the use of gE-negative (or other glycoprotein-negative) “marker” vaccines and appropriate discriminatory tests (Vannier et al., 1997; Siegmann, 1997; van Nes, 2001; Müller et al., 2003; Kornienko et al., 2020).

As for the spread of the disease, the presence of PRV among wild boars always increases the risk of the pathogen entering domestic pigs or other species of animals, etc. (Pedersen et al., 2013). European researchers also pointed to the spread of the virus through hunters (Keuling et al., 2008; Cano-Terriza, 2019). However, it should be borne in mind that in most cases, after contact with biomaterials from wild boars, domestic pigs themselves become carriers of the virus (Charrier et al., 2018). For the rest of animal species this disease is fatal (“epizootic deadlock of the pathogen”) (Kornienko et al., 2020).

Because PRV strains in wild boars are attenuated, these pathogens, by causing outbreaks in domestic pigs, can lead to the infection without the manifestation of the disease. This contributes to the fact that such outbreaks remain undetected for a long time and cause the further spread of the virus (Charrier et al., 2018). Seroconversion in such animals also occurs with a certain delay. The risks of transmission of the virus from wild boars to domestic pigs are a constant threat and require continuous monitoring. In addition, the PRV infects other species: dogs, cats, cattle, sheep, goats etc. (Pedersen et al., 2013; Di Marco et al., 2021). Recent studies show that the pathogen also affects humans, sometimes causing the development of encephalitis (He et al., 2019; Liu et al., 2021). In Ukraine, according to the official reports of regional laboratories of State Service of Ukraine on Food Safety and Consumer Protection and obtained data of State Scientific and Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise (SSRILDVSE, Kyiv, Ukraine) (reporting form 1-Vet. and 2-Vet.) over 1994–2020 one affected location and two sick dogs were found in Khmelnytska region (1999) and one sick dog in Mykolayivska region (2009).

The results of this work have been presented since 2009, as the actual research began only in 2008, when the “Program for the eradication of Aujeszky’s disease among swine in Ukraine over 2008–2012” was approved. The main elements of this program, the following measures were: specific vaccination against pseudoboruses by using gE-negative “marker” vaccines; conducting serological screening for the presence of antibodies to the glycoprotein gE; introduction of a ban on the import into Ukraine of pigs seropositive to PRV; on farms that do not isolate animals with antibodies for two years, vaccination is stopped and they are given the status of free from this disease; conducting serological monitoring in the wild fauna in order to identify the reservoirs of this disease; ensuring control over the implementation of veterinary and sanitary measures during the conducting of the preventive and health measures for this disease.

As a result of the implementation of these provisions of the program, the number of registered Aujeszky’s disease outbreaks among domestic pigs has significantly decreased in Ukraine. Thus, during 2008–2011 the number of locations affected by PRV ranged from three to four, and in 2012 (the last year of the program) only one such farm was registered in Zaporizka region. As a result of the conducted research, there is a clear trend that shows the reduction of the number of affected locations / farms for pseudoboruses among domestic pigs in Ukraine. Thus, in 2009 four such farms were found, and in 2018 – only one. During 2014–2016 and 2019–2020, affected farms and locations were not registered for this disease. In total, 21 such points with sick pigs were registered during the analyzed period. For comparison, according to official reports, the largest numbers of such locations (farms, households, etc.) in Ukraine were registered in the early 1990s and 2000s. Thus, in 1994, the eighteen such points were identified, and in 2001 and 2002 – thirteen and fifteen, respectively. As for wild boars, during the analyzed 12 years, locations affected by Aujeszky’s disease were registered only in 2013 and 2014 (two and one, respectively). It should be noted that all of them were found in the Autonomous Republic of Crimea.

In addition, we conducted an analysis of serological studies among wild boars and domestic pigs in Ukraine for the period 2009–2020. Studies on the presence of specific humoral antibodies to the PRV in the sera samples of these species were performed by the enzyme-linked immunosorbent assay that are discriminatory and recommended by the World Organization for Animal Health (OIE, 2018).

In order to conduct the research on PRV, we conducted an analysis of serological studies among wild boars and domestic pigs in Ukraine for the period 2009–2020. Studies on the presence of specific humoral antibodies to the PRV in the sera samples of these species were performed by the enzyme-linked immunosorbent assay that are discriminatory and recommended by the World Organization for Animal Health (OIE, 2018). Analysis of the results of serological studies among domestic pigs showed that the realization of plans during the implementation of the “Program for the eradication of Aujeszky’s disease among swine in Ukraine over 2008–2012” lasted from 2009 to 2012. The slight underperformance of these plans was observed in 2010 (57.7%), 2011 (74.4%), and 2013 (58.0%). At the same time, a significant overfulfillment of the
plan was registered in 2009 (125.9%). After the end of the recovery program, in the period 2015–2018, the implementation of research plans was only 2.6–10.3%. Serological studies among domestic pigs were not planned in 2019–2020. The largest number of seropositive swine was found during 2009–2010 (8.5–12.4%). During the whole investigation period, 378,678 blood sera samples from domestic pigs were actually tested and 27,397 positive reactions were detected, which is 7.4% of the total number of investigated.

Analysis of the results of serological studies among wild boars for the presence of antibodies to the Aujeszky’s disease virus showed that the planning and implementation of research effectively began only in 2009 (the beginning of the recovery program). By comparison, in the previous period of 2004–2008, only eleven sera samples from this species were studied. During the period of the implementation of the recovery program (2008–2012), plans were conducted within the range of 80.4–449.6%. Subsequently, in 2016–2018, we registered significant underperformance of plans, but it should be noted that research in these years was also conducted. Overall, during the whole investigation period, 9,052 blood sera samples from wild boars were tested and 1,788 positive reactions were detected, which is 19.8% of the total number of investigated.

In our opinion, it should be emphasized that during the analyzed period there is an irregular volume of serological studies among wild boars’ sera for different years of research. For example, in 2014, 1,935 samples were studied, in 2016 – only two samples, and in 2020 no research was conducted at all. In general, after 2014 the number of serological tests among both species for carriers of Aujeszky’s disease has significantly decreased.

Regarding the registration of the disease in these species from neighboring countries, the similar studies were conducted in Poland during 2011–2014. Thus, the seroprevalence of antibodies to PRV among wild boars in this country was 27.4% in the hunting season 2011/2012, 32.4% – in 2012/2013, and 35.5% – in 2013/2014. The total seroprevalence was 32.2% (Lipowski et al., 2017). In Russia molecular studies were performed by PCR among this species from the Moscow region and PRV carriers were identified in 2007 (Shcherbakov et al., 2007). At the same time, the literature regarding Aujeszky’s disease monitoring in Belarus, Romania and Moldova dates back to the 1970s (Belykh, 1970; Demidov & Kranova, 1975; Sorodoc & Sardin, 1979).

As a result of comparative geographical analysis of the obtained data on the detection of specific humoral antibodies to the Aujeszky’s disease virus among both species for 12 years in the regions of Ukraine, there is no established clear correlation between the spread of the disease in wild boars and domestic pigs. Thus, the highest seroprevalence rates among wild boars were observed in the northern and northeastern parts of Ukraine, and in domestic pigs, on the contrary, in the southern and central parts of this country.

Given the data obtained, it can be argued that the leading role in the spread of Aujeszky’s disease among domestic pigs in Ukraine is played by the following factors: violation of maintenance conditions, relocation of animals from farms affected by PRV, hypodiagnostics of the disease, violation of quarantine conditions, violation of the terms of susceptible livestock vaccination, etc. In our opinion, wild boars play a secondary role in the spread of Aujeszky’s disease among domestic pigs in our country.

During the period of validity of the provisions “Program for the eradication of Aujeszky’s disease among swine in Ukraine over 2008–2012”, there were significant trends in the direction of recovery of our country from this disease. Thus, in the first years after the end of this Program (2014–2016), no affected locations were registered at all for either domestic pigs and other animal species. It should be noted that since 2014 the number of serological tests among both species for carriers of Aujeszky’s disease has significantly decreased.

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