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Communication

Seroprevalence of Viral Enzootic Diseases in Backyard Farms in Serbia

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Simple Summary: Infectious diseases are considered one of the main challenges to pig production despite continuous health management and biosecurity improvement. Hardly to control, backyard farms are considered a high-risk infection source for commercial farms. However, despite many concerns, backyard farms are nowadays becoming popular as they respect environmental protection and animal welfare more than commercial farms, viewed as socially unacceptable. Though we discovered that Porcine Parvovirus infection and Aujeszky`s disease are wildly present in backyard pigs, almost half are free from all-tested diseases. Being the mirror of wild boar health and the link between wild boars and commercial farms, backyard farms have to be put under control as they can interfere with countries' eradication programs.

Abstract: Contrary to pig farming in developed western countries, in a large part of the world, pigs are still traditionally kept, in small backyard farms, usually for family needs. Their main characteristics are low biosecurity, swill feeding, natural breeding and uncontrolled trade. Given the high number of backyard farms in Serbia and the risk they are thought to pose to intensive pig farming, the main aim of this study was to evaluate the prevalence of major viral diseases of swine among traditionally kept pigs in small holdings with low biosecurity. For this investigation, 222 serum samples from 69 backyard holdings were randomly selected and tested for PRRS, Aujeszky`s disease, PPV infection and Swine influenza by ELISA. The herd-level seroprevalence of PRRS, Aujeszky`s disease and PPV infection was 2.9%, 27.5% and 37.7%, respectively. Swine influenza seroconversion was not confirmed in any of the tested holdings. Despite widely distributed PPV and AD in backyard farms in Serbia, almost 50% of them are still negative for the all-tested disease. The backyard farms must be monitored, and owners educated as their role in eradication programs and obtaining country-free status may be crucial.

Keywords: enzootic viral disease; backyard farm; PPV; Aujeszky`s disease; PRRS; Swine influenza; Serbia

1. Introduction

The increase in market demands and pork meat consumption was addressed by increasing the number of farming animals and/or improving the efficiency of the pork production sector. However, the larger herd sizes led to the emergence of many enzootic diseases. Although intensive pig farming

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is leading in utilising of both technological and scientific advancements, veterinarians and producers still face infectious disease outbreaks. Infectious diseases are considered one of the main challenges to pig production despite continuous health management and biosecurity improvement. The financial impact due to the direct and indirect losses such as higher mortality, fewer number of piglets per sow, less meat produced, lower feed conversion, and healthcare costs are substantial [1] [2]. The viral diseases with the highest economic and health impacts are those causing Porcine Respiratory Disease Complex (PRDC), primarily porcine reproductive and respiratory syndrome (PRRS), porcine circovirus type 2 infection (PCV-2), and swine influenza (SIV). Aujeszky`s disease (AD) and porcine parvovirus (PPV) infection are also contagious diseases with significant economic impact. However, AD has been eradicated in many European countries, the U.S., New Zealand and Japan [3], and PPV infection is controlled by vaccination [4]. Contrary to pig farming in developed western countries, in a large part of the world, pigs are still traditionally kept, in small backyard farms, usually for family needs. These farms are invisible and uncontrolled by state veterinarians. Their main characteristics are low biosecurity, swill feeding, natural breeding and uncontrolled trade. Thus, since the health status of backyard farms is unknown, they are considered a high-risk infection source for commercial farms [5], [6]. Furthermore, the country's disease status can certainly be compromised since disease control is hardly achievable. Despite many concerns, backyard farms are nowadays becoming popular as they respect environmental protection and animal welfare more than commercial farms viewed as socially unacceptable. In Serbia, the majority of pig farms are small, backyard farms [7], contrary to EU where only 0.7% of pigs are kept outdoor [8]. Given the high number of backyard farms in Serbia and the risk they are thought to pose to intensive pig farming, the main aim of this study was to evaluate the prevalence of major viral diseases of swine among traditionally kept pigs in small holdings with low biosecurity. PRRS, AD, PPV and SIV were selected based on their prevalence and significance for commercial pig farming in Serbia, where AD is still present and no eradication program is in place. Considering how the pigs in backyards are raised, the working hypothesis was that the prevalence of selected viral diseases is more likely similar to those in the wild boar population rather than on commercial farms.

2. Materials and Methods

For this investigation, 222 serum samples from 69 backyard holdings were randomly selected from the classical swine fever ongoing surveillance. Each pig residing on the selected holdings was sampled and tested. The data on the holding category according to the total number of swine and the number of sows were obtained from the State Central database. For the antibody detection, commercial ELISA kits were used following manufacturer`s instructions: PrioCHECK PRRSV Ab, Prionics, INgezim Influenza A, Gold Standard Diagnostics, PrioCHECK PRV gB ELISA Prionics and INgezim PPV Compac, Gold Standard Diagnostics. The chi-square test was used to evaluate the significance level of association between farm categories and disease seroprevalence.

3. Results

According to the total number of swine on a farm, all selected holdings belonged to the category of up to 10 pigs. According to the number of sows, three farms (4.4%) had no sows, 46 farms (66.7%) kept up to two sows, and 20 farms (29%) belonged to the category with 2-10 sows (Table 1).

Table 1. Herd-seroprevalence according to the farm category.

Farm category	No (%)	PRRS			PPV infection			AD		
		neg	pos	%	neg	pos	%	neg	pos	%
No sows	3 (4.4)	3	0	0.00	2	1	33.33	2	1	33.33
1-2 sows	46 (66.7)	45	1	2.17	29	17	36.96	35	11	23.91
3-10 sows	20 (29)	19	1	5.00	12	8	40.00	13	7	35.00
SUM		67	2	**2.9**	43	26	**37.7**	50	19	**27.5**

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The overall seroprevalence was 2.7% for PRRS, 17.1% for AD and 25.7% for PPV infection (Figure 1).

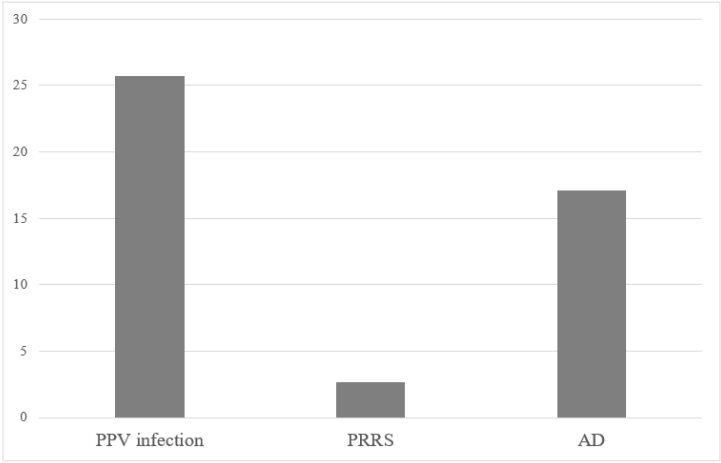

Figure 1. Overall seroprevalence of PRRS, AD and PPV infection in backyard farms in Serbia.

The herd-level seroprevalence of PRRS, Aujeszky`s disease and PPV infection was 2.9%, 27.5% and 37.7%, respectively (Table 1). SIV seroconversion was not confirmed in any of the tested holdings. The proportion of seronegative backyard herds for the four diseases was 68.1%. Mono PRRS infection was detected on two farms (2.9%), PPV infection on 20.3%, and Aujeszky`s disease on 10.1% (Table 2).

Table 2. Herd seroprevalence of negative and mono Infections for PRRS, PPV, and AD in farms categorized by sow numbers.

	No sows		1-2 sows		3-10 sows		SUM %
	No	%	No	%	No	%	
Negative	2	66.7	24	52.2	8	40.0	49.3
Mono PRRS	0	0.0	1	2.2	1	5.0	2.9
Mono PPV	0	0.0	10	21.7	4	20.0	20.3
Mono AD	0	0.0	4	8.7	3	15.0	10.1
PPV+AD	1	33.3	7	15.2	4	20.0	17.4

Simultaneous PPV infection and Aujeszky`s disease was detected in 17.4% of farms (Table 2). Within-herd, the prevalence ranged 20%-100% for PPV infection and 33%-100% for Aujeszky`s disease. PRRS within-herd seroprevalence was 100% in both holdings where seroconversion was confirmed. A chi-square test showed that there was no significant association between farm categories and seroprevalence.

4. Discussion

Outdoor farming allowed in the EU can be considered different from traditionally kept pigs in backyards in the Balkans. While outdoor farming in the EU means permanent or temporary keeping of pigs outdoors, the pigs in backyard farms in the Balkans are usually kept closed with no outdoor access. This practice is seen in other countries, such as Cyprus [8]. In the context of biosecurity measures, farms in Serbia are classified into four distinct categories. Among these, both family farm type B and backyard farms, which were the focus of this study, are characterized by minimal to nonexistent biosecurity protocols [9]. Further, pig farms in Serbia are divided according to the number of pigs (up to 10 animals, 11-50 animals, 51-100 animals, 101-500 animals, and more than 500 animals) and the number of sows (no sows, 1-2 sows, 3-10 sows, 11-50 sows, and more than 50 sows). This study was conducted on backyard farms with up to 10 animals, farms with no sows, and farms keeping 1-2 and 3-10 sows. A typical backyard farm in Serbia is partially fenced or unfenced, with no

control over persons visiting the animals or quarantining newly purchased animals [9]. It is important to recognize that wild boars and domestic pigs may come into contact in certain regions, leading to the possibility of boar-pig hybrids. However, this interaction and potential hybridization present a significant risk for the introduction of various pathogens or novel strains into the backyard pig population, with potential implications for biosecurity and disease control. Another concerning fact is enabled contact of pigs on the holdings with other animal species, wild boars among others, thus pathogen transmission is uncontrollable and almost certain. Although forbidden, swill feeding is still widely distributed practice. As stated before, natural breeding, uncontrolled trade, unknown health status of residing animals are additional concerns to be discussed in terms of threatening disease spread. Backyard farms, thus, co-exist independently with industrial farming. At the same time, humans are the main link between them, as backyard farmers are usually employed at commercial farms. While regulations may prohibit the keeping of pigs in domestic or non-commercial environments, enforcement of these rules can be challenging, leading to potential non-compliance. Therefore, backyards are considered the main risk of pathogen introduction into a commercial farm [10]. This study revealed that SIV is very likely not present in backyard pigs, while PRRS seroprevalence is at a very low level (2.7%). Conversely, PPV infection and AD are commonly present in the backyard swine population in Serbia. The initial hypothesis is confirmed, knowing the epidemiology of selected diseases and their distribution in wild boar [11] [12]. SIV and PRRS are typical for intensive production since they can be efficiently transmitted via different routes. They require dense populations and naïve animals that are undoubtedly present in different production phases [13]. Conversely, as none of these conditions are fulfilled in backyard farms, the more common diseases are those that can be transmitted from wild boar, including parasites [13]. SIV in Serbian commercial farms is the most common respiratory disease [14], represented by H1N1, including H1N1pdm09 lineage and H3N2 subtypes [15]. The seroconversion in the wild boar population in Serbia has not been reported [11]. In the wave of influenza outbreaks across Europe in recent years, Serbia experienced specific incidences of the disease within backyard poultry populations. During the 2016/2017 period, a total of four outbreaks were officially recorded, followed by a subsequent occurrence of three outbreaks in the 2021/2022 period [16]. Despite the common practice of keeping pigs and poultry together in backyards, no spillover and seroconversion in backyard pigs in this study were detected, which might be due to the short life of backyard pigs, as well as fast actions to limit the infection in poultry [16]. A similar situation with sporadic spillovers from poultry to pigs is seen in Europe [17]. PRRS, the most significant disease in commercial farming, is also common in Serbian farms, with seroprevalence of up to 70% depending on the region [18]. However, according to this study's results, the prevalence depends on the farm type, as the backyard farms are commonly free from PRRS. For this reason, PRRS was decided to be eradicated from backyard farms in Hungary [19]. Our findings regarding the PRRS are consistent with generally low PRRS seroprevalence in wild boar [20] [21]. Backyard population and wild boars are not reservoirs of PRRS, as the prevailing conditions do not provide efficient virus transmission and maintenance. PPV infection is enzootic in wild boar and domestic pigs [22]. PPV is widely distributed in European wild boar populations, with the seroprevalence reaching 100% [23]. In Serbia, 37.7% of backyard farms are infected with PPV, whereas the average seroprevalence within the farm is 65%. Similar results are reported from other countries with most backyard farms [24] [25]. Except for reproductive failure in gilts, the infection is inapparent in domestic pigs and wild boar [25]. Due to the virus resistance, contaminated facilities and equipment are the primary source of the virus in backyard farms, which is why the animals get infected and develop an immune response very early, which can explain the high within-herd prevalence. While members of *Suidae* family are the natural hosts of the Pseudorabies virus causing Aujeszky's disease, wild boars are considered its reservoir. In industrial pig farming, AD causes substantial losses. Thus, it is one of the primary diseases for eradication. However, in wild boar and feral pigs, AD is often subclinical and with unspecific clinical signs. In Serbia, there is no control or eradication plan for AD in domestic pigs. The indirect indicator of AD prevalence in domestic pigs, primarily in backyards, are the outbreaks in carnivores, mainly diagnosed within the rabies surveillance program in terms of differential diagnosis (unpublished data). This study reveals that

one-quarter of backyard pig farms are infected with AD, whereas within-herd prevalence is sometimes even 100%. Similarly, the average seroprevalence in wild boar populations in Europe is around 30% [26] [27], but can reach even 100% in certain subpopulations [28].

5. Conclusions

Despite widely distributed PPV and AD in backyard farms in Serbia, almost 50% of them are still negative for the all-tested disease. Undoubtedly, the direction of disease transmission is mainly from backyards to commercial farms. The other direction certainly can happen, but this is hardly probable due to the specific conditions in backyard settings. Thus, monitoring of backyard farms health status must be considered thoughtfully, emphasizing the need of improving biosecurity measures. Education of owners and their role in eradication programs and obtaining country-free status may be crucial.

Author Contributions: VM and BK conceived and planned the experiments, DG and ZZS carried out the tests, BM contributed to the interpretation of the results, JM and NJ contributed to sample preparation and performed the statistical analysis. All authors discussed the results and contributed to the final manuscript.

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