BioRisk 17: 287–296 (2022)
doi: 10.3897/biorisk.17.77398
https://biorisk.pensoft.net

RESEARCH ARTICLE

A peer-reviewed open-access journal
BioRisk

Evaluation of viral infection levels in intensive and organic poultry farming

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Academic editor: R. Metcheva | Received 31 October 2021 | Accepted 18 January 2022 | Published 21 April 2022

Citation: Kirov PM, Alexandrova RI (2022) Evaluation of viral infection levels in intensive and organic poultry farming. In: Chankova S, Peneva V, Metcheva R, Beltcheva M, Vassilev K, Radeva G, Danova K (Eds) Current trends of ecology. BioRisk 17: 287–296. https://doi.org/10.3897/biorisk.17.77398

Abstract

Whereas early organic farming was mainly focused on plant production, in the last decade, the number of organically-managed poultry farms within the European Union has increased significantly. Similar to organic crop production, organic animal farming is based on the same principles: welfare-friendly, sustainable production and resource utilisation without or with very little addition of synthetic substances, such as antibiotics and antiparasitic treatments. These practices, as well as the access to wild animals, make the free-range poultry production systems predisposed to different viral diseases and, thus, associated with potentially higher public health risks or reduction in production quality. On the other hand, intensive farming amplifies the impact of viral diseases due to high density, low genetic diversity and elevated immunodeficiency. The aim of this analytical study is to compare free-range with intensive poultry systems and the occurrence of different viral diseases in these types of farms in the EU over the past decade. The research is based on official data from the statistical office of the European Union, as well as official data from the Member countries. The results were similar in each country and demonstrate that free-range production has a higher incidence of viral diseases with high zoonotical potential. This makes year-round surveillance absolutely necessary, as well as the need for implementation of additional criteria and requirements towards free-range systems.

Keywords

European Union, farming systems, free-range poultry, intensive farming, meat production

Introduction

In recent years, we have observed the characteristics, defined by Armelagos et al., of the Third transitional period in infectious diseases (Armelagos et al. 1991). This transitional period is characterised by the re-emergence of pathogens already considered eradicated or under control, as well as new pathogens (for example: HIV, SARS, MERS, SARS-CoV-2) and increasing antibiotic resistance. In addition to the recurrence of these viral diseases, some of them have significantly increased virulence (Barrett et al. 1998). According to other studies, human intervention and, in particular, the effects on the environment as a result of modern agricultural practices, are crucial for the emergence of these phenomena (Lebarbenchon et al. 2008).

The present study aims to trace the situation in the European Union with regard to the various poultry farming systems – both traditional and organic. Wild birds as a vector of viral diseases are also considered as a factor.

Demand for products produced by organic farmers has grown significantly over the last decade. The Council of the European Union defines organic farming as a system of food management and production that combines best practices in terms of environmental protection, high degree of biodiversity, protection of natural resources, application of high standards of animal welfare and a production method tailored to the preferences of some consumers for products produced using natural substances and processes (EC 2007).

On the other hand, intensive poultry farming, with a high density of animals in confined spaces, is a system with conditions significantly different from those of organic farming and wild birds. At the same time, the use of a number of drugs and modern vaccines in intensive care systems aims to protect animals from a number of pathogenic factors. In organic systems, significantly limited drug use would be a factor for allowing the easy spread of pathogens amongst herds, which, on the other hand, would be limited by significantly lower stocking densities compared to intensive systems. The introduction of specific requirements for organic production in terms of cultivation methods - regular control of certain infectious diseases, the requirement for indoor feeding etc. – is successful in terms of protection against a number of bacterial and parasitic diseases (Wierup et al. 2017) (Thapa et al. 2014). Despite these results, the presence of an outdoor area where birds spend most of the day poses a high health risk for some viral diseases (such as bird flu) compared to intensive care systems (Koch and Elbers 2006; Gonzales et al. 2013).

Based on these studies, it is difficult to determine whether organic systems pose a lower health risk to the population or a higher risk. At the same time, there is a significant increase in interest in organic farming in the European Union: doubling the size of organic farms compared to those with intensive production, more than 70% increase in the size of organic farming land within 10 years (EC 2019).

To date, analytical studies, based on data from Member States, have focused on an annual period and are published annually on the European Food Safety Authority (EFSA) website. Therefore, the aim of our study is to use and analyse data from a period

of time longer than 5 years. The advantage of using the results of the EU Member States is the collection and processing of data collected on the basis of unified criteria and through the use of uniform formats. In other words, EU Member States can present themselves as a country consisting of 27 districts. This, in contrast to previous studies, eliminates the problem of the lack of heterogeneity of input information - criteria and mechanisms of collection, all giving maximum statistical reliability of the processed data.

This study will examine the levels of infectious risk in traditional and organic systems in order to further clarify the presence of zoonotic risk in different systems, referring to the data recorded by individual Member States in the period 2012–2020.

Materials and methods

When selecting indicators in the design of this study, we focused on the following parameters: viral disease of zoonotic nature or having the potential for such, developed reliable methods of diagnosis, diseases subject to mandatory control and reporting by Member States and prevalence or establishment giving statistically significant results. West Nile Virus and Avian Influenza, considered as the two viral diseases in birds requiring mandatory reporting, were taken into account Council Directive of 30 November 2009 (EC 2009). The data for the registered cases are given in Table 1. For Avian Influenza, the count for registered cases is consolidated between High Pathogenic Avian Influenza (HPAI) and Low Pathogenic Avian Influenza (LPAI).

Referring to the indicated data and the p-values, both determining the use of data for Avian Influenza (AI) as a statistical indicator, give a better expression of the purpose of the present study.

Data collection and processing

This study is based on official data from the European Union Member States official reports. The parameters on which these reports are prepared and submitted are set in Directive 2010/367 (EC 2010). Data for the period from 2012 to 2018 are publicly available on the website of the European Food Safety Authority (EFSA) at: https://www.efsa.europa.eu/en/publications. Starting from the beginning of 2019, the data have been submitted in SSD2 format and can be found on the EFSA website Knowledge Junction community on ZENODO at: https://zenodo.org/. SSD2 format specifications are defined in (European Food Safety Authority 2019).

Table 1. Compulsory Notifiable Diseases cases registered in the European Union for year 2019. (European Food Safety Authority 2021; European Food Safety Authority 2020).

Compulsory Notifiable Diseases	Registered Cases
Avian Influenza (HPAI and LPAI)	1320
West Nile Virus	107

The data collected for the period 2012–2018, in the form of statistics from the annual reports themselves (available as PDF files at the above address) and datasets in SSD2 format with data for 2019–2020 were entered in separate databases. These datasets were processed with the software SPSS 28 (https://www.ibm.com/analytics/spss-statistics-software), with which the graphs in the study were produced.

For the purpose of the present study, the categories described in the EU Commission Decision of 25 June 2010 (EC 2010) are grouped into two categories, based on: access to open spaces, use of drug prophylaxis and treatment, similarities to provided care and give the following results:

- Conventional (Conv) consists of the following: laying hens, chicken breeders, turkey breeders, duck breeders, geese breeders, fattening turkeys, fattening ducks, fattening geese, farmed game birds and ratites (flightless birds);
- Category Free-range/Backyard (FrBy), consists of free-range laying hens, free-range broilers and backyard flocks.

Limitations

The data for this study were submitted by the relevant organisations from the Member States, according to an EU Commission Decision of 25 June 2010 (EC 2010). This could lead to differences in reported data, especially for wild birds, between databases: EFSA, Animal Disease Information System (ADNS) the World Animal Health Information Database (WAHID) or individual national surveillance databases.

The data for backyard flocks are combined with those for free-range. The reason is the proximity of the mechanisms and principles of poultry farming in both systems - by definition backyard flock is a flock of poultry raised in close to natural conditions and are not part of industrial production (not part of a registered farm) (Truscott et al. 2007; Sharkey et al. 2008).

Values for wild birds were collected by the "passive" method and for farm birds by the "passive" and "active" methods.

The results for Croatia, which joined the EU on 1 January 2013, are not included in the 2012 data.

Results

General overview

For the period between 2012 and 2020, a total of 316115 tests for HPAI and LPAI were performed within the territory of the European Union, of which 7511 (2.38%) are the total number of positive tests for HPAI and LPAI. Of the tests, 139821 (44.23%) were for birds in intensive farming systems, 73792 (23.34%) for birds in

organic systems or backyards and 102502 (32.43%) for wild birds. Of these tests, intensively reared animals tested positive in 1008 cases (13.42% of all positive results or 0.78% of Conv), 1222 cases (16.27% of all positive results or 1.65% of FrBy) in organic and backyard and 5281 cases in wild birds (70.31% of all positive results or 5.15% in these birds).

Member States report approximately constant proportionality in conventional systems. In organic and backyard systems, taking into account the statistics of a steady increase in the number of birds raised by these methods, the number of tests performed remains relatively low. (EC 2019). The summary data for the period covering 2012 to 2020 are presented in Table 2 and graphically in Fig. 1.

For the period 2012 to 2018, the tested conventional systems represent an average of 15.19% of the total. In the free-range birds, in the period 2012–2015, an average of 11.19% of the total number was tested and for 2015–2018, the percentage increased to 24.93%. Backyard flocks continue to occupy a very low part of the collected data, with an average ratio of 0.43% tested (Fig. 2).

Table 2. Annual representation of Avian Influenza sampled and positive results for the period 2012–2020.

		2012	2013	2014	2015	2016	2017	2018	2019	2020
Conventional Farming	Total number of sampled	20726	19075	14402	16910	17804	12292	12350	14721	11541
	Total number of positive results	42	56	53	73	74	136	96	287	191
Free-range/Backyard	Total number of sampled	8779	6127	4419	4959	4957	4532	21498	9698	8823
	Total number of positive results	5	12	4	8	8	25	903	135	122
Wild Birds	Total number of sampled	6504	6563	5676	6730	6760	19325	12879	19097	18968
	Total number of positive results	65	26	30	75	71	1905	587	898	1624

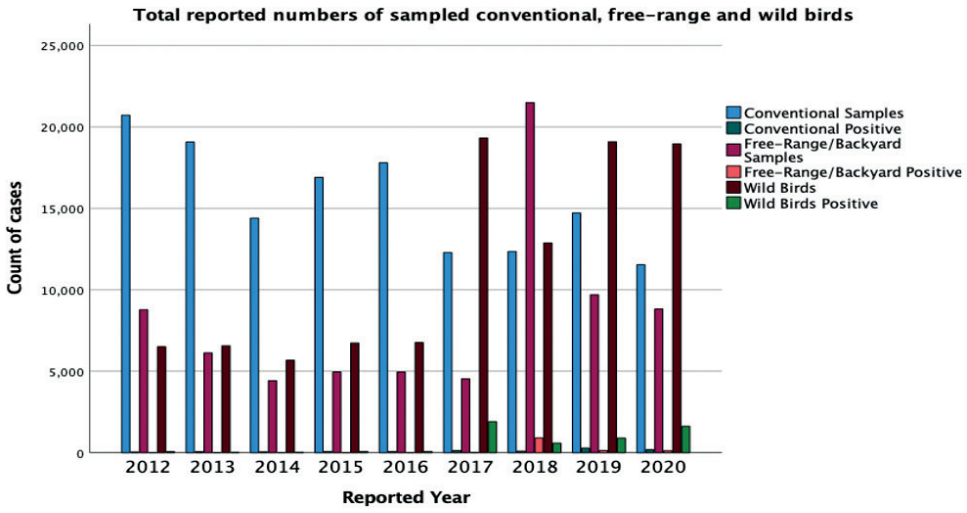

Figure 1. Graphical representation of the Avian Influenza samples and positive results in conventional systems, free-range and backyard farming and in wild birds between 2012 and 2020.

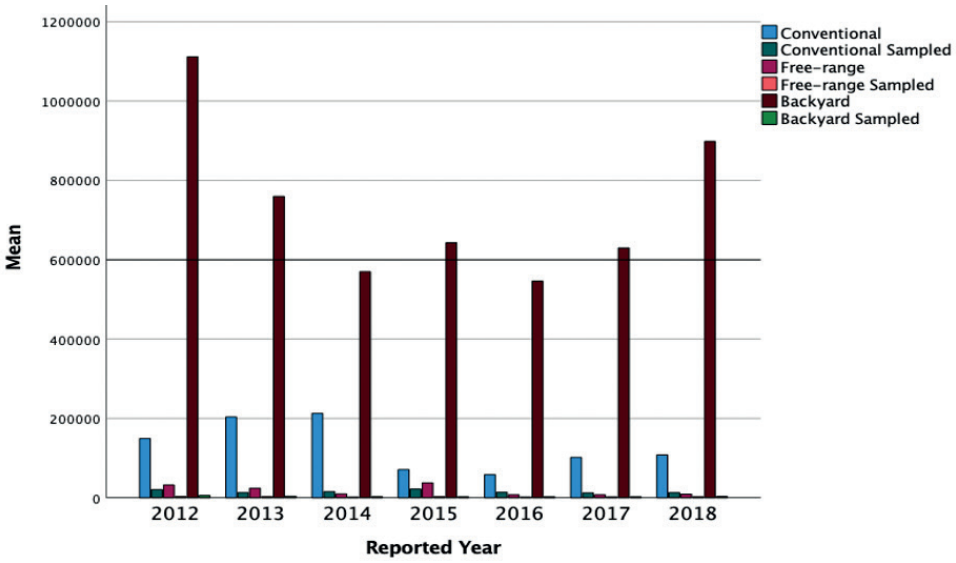

Figure 2. Graphical representation of the ratio between total and sampled for Conventional, Free-range and Backyard between 2012 and 2018.

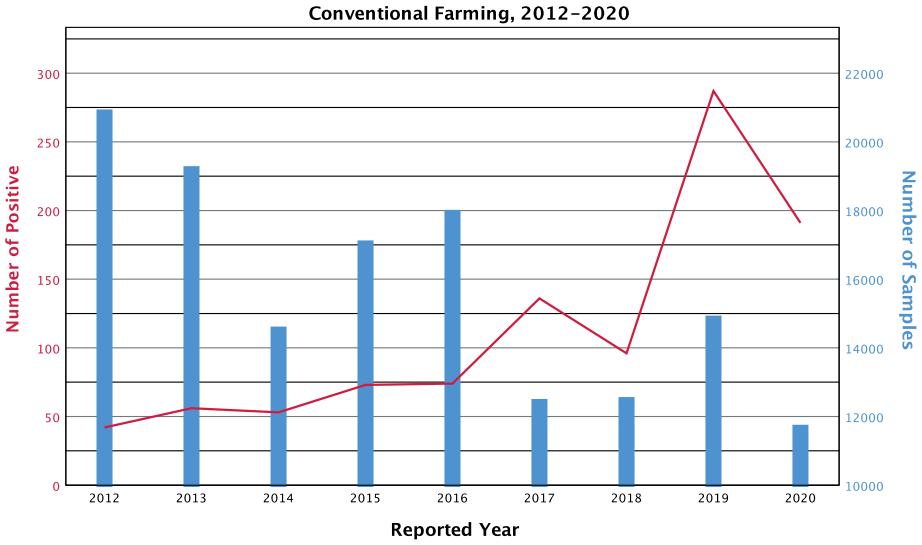

Figure 3. Bars represent the total number of samples and the red line the total number of positive results between 2012 and 2020.

Conventional farming

From the collected data for the intensive systems, compared to previous years, there is a gradual decrease in the number of tests at the end of the study period. In parallel, there is an increase in the number of tests ending with a positive result (Fig. 3). Detailed distribution is demonstrated in Table 2.

Free-range and backyard farming

The tests performed on birds in organic systems or backyard in the period 2012–2020 total 73792, representing 23.34% of the total number for all categories. In the positive tests, the ratio is close to that of the intensive systems: 16.27% in the organic, against 13.42% in the intensive (Fig. 4)

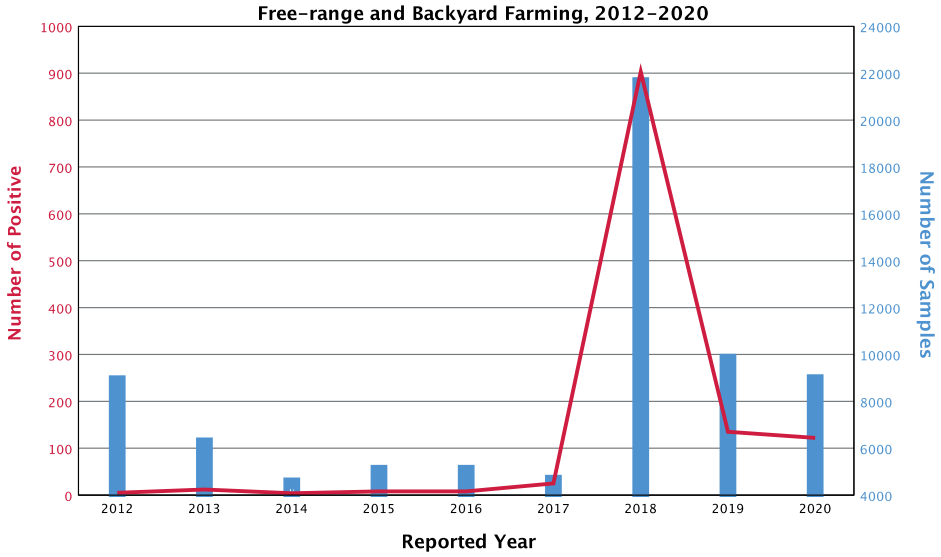

Figure 4. Bars represent the total number of samples and the red line the total number of positive results for free-range and backyard between 2012 and 2020.

Wild birds

From 2017, wild birds constitute the predominant part of the tested categories: 18.06% in 2012 to 48.23% in 2020. Positive results in wild birds have the highest value of the three categories and show an increasing trend. The minimum ratio between the birds tested by the passive method and those that gave a positive result for HPAI or LPAI is 27.66% (2013) and the maximum is 92.21% reported in 2017. There is a positive trend in the increase in the number of tested birds compared to previous periods (Fig. 5).

Discussion and conclusions

The number of consumers of organic products is constantly growing and is based on various motives, such as the belief in better taste, welfare of farm animals, low levels of unnecessary use of antibiotics and growth stimulants etc. This leads to a constant increase in the number of producers of organic products (EC 2019). The regulatory framework

for organic production in the European Union is defined in Council Regulation (EC) No 834/2007 (EC 2007). One of the questions from consumers of organic products is related to whether the risks to human health from zoonotic diseases transmitted by farm animals are higher than in conventional agricultural production. Despite the limited use of anti-infectious drugs, previous studies have shown no significant differences in the level of infectivity with potential human infections between the two types of agricultural production (Miranda et al. 2008; Young et al. 2009; Smith-Spangler et al. 2012).

Data from Member States for the period 2012 to 2020 show minimal differences between intensive and organic production in terms of HPAI or LPAI infectivity. These minima are probably due to the increased requirements for organic production, with the better health of animals on organic farms (Anderson 2011).

Wild birds continue to be a major source and reservoir of HPAI and LPAI. The annually increasing number of positive results in passive control in wild birds raises the requirement and need for the development of active control methods. Access to free-range and backyard open areas for most of the day creates an increased likelihood of farm animals coming into contact with wild birds. The lack of a high percentage of positive tests in Conv relative to FrBy may be the result of the insufficient number of tests in organic and backyard birds. The graphics in Figs 4, 5 show significant similarities between the levels of positive tests in free-range and backyard birds on the one hand and wild birds on the other. This determines the expected increase in the difference between organic and intensive cultivation methods with a future increase in the number of tests in the organic sector.

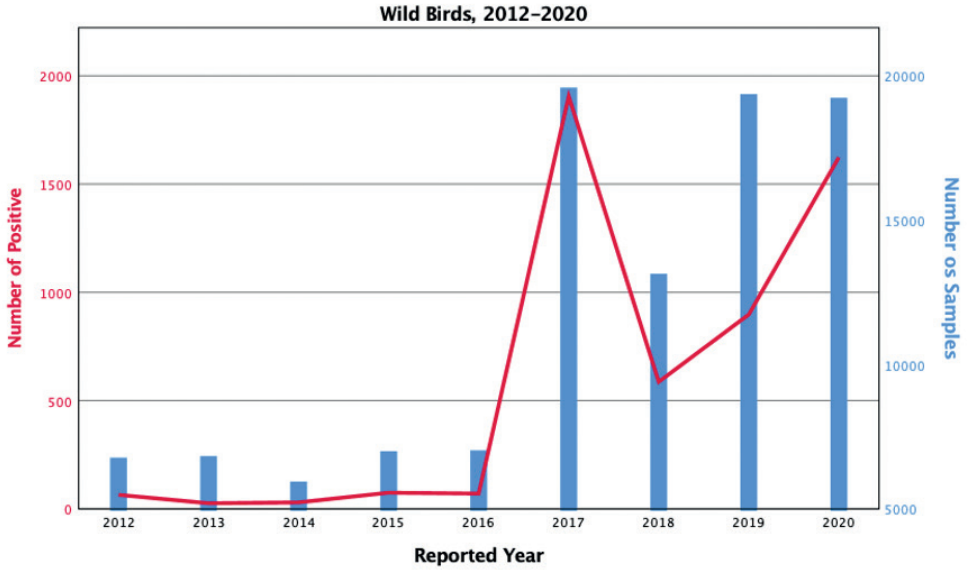

Figure 5. Bars represent the total number of samples and the red line the total number of positive results for wild birds between 2012 and 2020.

As a first of its kind analytical study, the observed trend in annual gradual increases in positive results in wild birds and the symmetry of related results in FrBy, necessitate the expansion of the present study by adding data from subsequent years and analysing trends, based on aggregated data.

The results were similar in each country and demonstrate that free-range production has an annually increasing number of incidences of viral diseases with high zoonotic potential. This makes year-round surveillance absolutely necessary, as well the need for implementation of additional criteria and requirements for free-range systems. Data collection and analysis need to continue in the future. The current study could be a starting point for similar studies in the coming years.

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