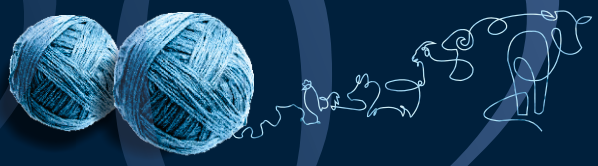
14th
INTERNATIONAL
SYMPOSIUM

MODERN TRENDS IN LIVESTOCK PRODUCTION

2023



PROCEEDINGS

4 - 6 October 2023, Belgrade, Serbia

Institute for Animal Husbandry

Belgrade - Zemun, SERBIA

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ASSESSMENT OF THE CURRENT STATE OF BIOSECURITY MEASURES ON BROILER CHICKEN FARMS WITH DIFFERENT CAPACITIES IN VOJVODINA

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Invited paper

Abstract: The broiler production faces many challenges, which can cause negative effects on their health and welfare. The great importance for farmers is to prevent disease outbreaks, and biosecurity measures are very significant. This study aimed to quantify the level of biosecurity measures in broiler farms of different capacities, using a standardized procedure, and to identify key aspects that would require improvements. The research was conducted from May to September 2022, and 15 randomly selected broiler farms participated. Five large-size (>30,000 chickens), five middle-size (10,000-30,000 chickens) and five small-size farms (<10,000 chickens) were analyzed. All farms are located in Vojvodina and farmers agreed to participate in the survey. The Biocheck.UGent scoring system (https://biocheckgent.com/en) was used to quantify biosecurity measures. The overall farm biosecurity is a weighted average of the external and internal biosecurity. Our results showed a low level of implementation of internal and external biosecurity measures on all farms (40-63%). The overall rating of biosecurity on farms was lower than the world and country's average. The results of this study suggest that the control of implemented biosecurity measures in broiler farms is very important. Most of the biosecurity risks for broiler farms originate from inappropriate site selection, purchase of day-old chicks of unknown quality, lack of procedures, and training of farm employees. This study should provide a good encouragement for the development of a biosecurity plan, identifying risks and the appropriate way to educate farm owners, as well as farm employees, on the implementation of biosecurity measures.

Key words: broilers, biosecurity measures, questionnaire, farm

Introduction

Poultry production is characterized by a huge variety of production systems with different production volumes, bird species, biosecurity measures, and production inputs and outputs *(Van Steenwinkel et al., 2011).* Broiler production is one of the main branches of animal husbandry and over 10 million tons of chicken meat are produced in the European Union in one year *(Luiken et al., 2019).* Such intensive production faces many challenges every day that can cause negative effects on the health and welfare of chickens and consequently lead to a decrease in production results, an extension of the production cycle, and poor profitability *(Butcher and Miles, 2012; De Paul Tatfo Keutchatang et al., 2021).* The risk of infectious diseases may be increased due to high population density, inadequate ventilation, and immunosuppression *(Tilli et al., 2022).* For this reason, it is of great importance for farmers to prevent disease outbreaks *(Gelaude et al., 2014),* especially if the disease is zoonotic or food-borne with potentially large consequences for public health *(Astill et al., 2018).* For many years, the prevention of the occurrence of the disease has been carried out by the preventive use of antibiotics, which led to the increasing development of antimicrobial resistance in veterinary and human medicine (*Gelaude et al., 2014; Luiken et al., 2019; Caekebeke et al., 2020; Dhaka et al., 2023).* Therefore, biosecurity measures are of key importance in the prevention of animal diseases on farms *(Gelaude et al., 2014).* Various factors are thought to play a role in a producer's decision to adopt different biosecurity measures, including farm and producer characteristics (flock size, years of experience, and risk awareness), local factors (prevalence of endemic diseases) and implementation-related factors (financial costs and ease of adoption) *(Greening et al., 2020).*

Assessment of biosecurity measures on broiler farms is carried out worldwide *(Greening et al., 2020; Ahmed et al., 2021; de Oliveira Sidinei et al., 2021; Dhaka et al., 2023).* Biosecurity measures are all those measures that aim to reduce the entry and spread of pathogens on the farm *(Ali et al., 2014).* The *World Health Organization (2010)* defined biosecurity measures as "an integrated approach for managing risks to human, animal and plant life and health". With increasing farm size and proximity to poultry houses, biosecurity has become an increasingly important measure *(Bernd et al., 2022).* The Food and Agriculture Organization of the United Nations recommends strict application of biosecurity measures as the most effective way to prevent and control the spread of the virus and prevent transmission to humans. Biosecurity is defined as all measures taken to prevent the introduction and spread of infectious agents on the farm and is a major factor influencing the occurrence of disease and the use of antimicrobial agents

(Cuc et al., 2020). Biosecurity measures are a key element in the control of endemic diseases *(Kouam et al., 2018).*

Activities in the form of restricted movement of people, quarantine and isolation of animals, animal transport protocols, fencing protocols, cleaning and disinfection of facilities are very effective in improving biosecurity. Biosecurity measures are divided into three components: isolation, traffic control, and sanitation. Isolation is a measure related to physical barriers (fences, showers, or disinfection barriers) and distance between farms, to prevent contact between sick animals and contaminated houses with the non-infected house. Traffic control refers to restrictions on the movement of feed, people, equipment, and animals on the farm *(FAO, 2008).* Sanitation refers to the cleaning and disinfection of poultry houses, agricultural machines, vehicles, and equipment *(Kouam et al., 2018).* Setting up hygienic barriers between the indoor and outdoor environment, controlling the entry of personnel, strict hygiene rules (hand washing and disinfection), and changing boots and coveralls before entering the farm have proven to be very effective measures *(Sibanda et al., 2018).* By preventing contact between poultry and infectious agents, infected and healthy birds, birds, and humans, the level of biosecurity on the farm is increased *(Ahmed et al., 2021).*

Biosecurity research on broiler farms is often based on qualitative questionnaires specifically designed for a certain disease, or focused on general biosecurity measures. To be able to objectively compare the level of biosecurity between farms or within a farm over time in a standardized way, it is necessary to quantify the level of biosecurity measures. Biosecurity measures are assessed using questionnaires (or similar tools such as checklists) in which the assessor answers several questions related to the measures applied *(Tilli et al., 2022).* Once risk factors are identified, customized health and biosecurity monitoring plans can be made for each farm *(Schreuder et al., 2023).* For this purpose, several scoring systems have been developed, and one of the most commonly used is BioCheck.UGent *(Van Limbergen et al., 2018).* Many technological recommendations have been made on biosecurity measures for large commercial farms, but these measures are not always applicable to small-size broiler farms *(Negro-Calduch et al., 2013).* For this reason, it would be very useful to analyze small-size farms as well, to establish biosecurity risks.

This study aimed to quantify the level of biosecurity measures in broiler farms of different capacities using a standardized procedure and to identify key aspects that would require improvements. In this way, in addition to large farms, the main risks would also be observed on small farms, which would contribute to the improvement of biosecurity.

Material and Methods

Study design

The research was conducted from May to September 2022. Fifteen randomly selected broiler chicken farms participated in the study. Five large-size (>30,000 chickens), five middle-size (10,000-30,000 chickens) and five small-size farms (<10,000 chickens) were analyzed. All farms are located in the province of Vojvodina and all farmers agreed to participate in the survey on biosecurity assessment. On all farms, chickens were reared on the floor. The province of Vojvodina consists of three regions (Srem, Banat, and Bačka), and poultry farming is very developed in each of them. There is a large agglomeration of broiler chicken farms. Two types of hybrids are most often present (Ross 308 and Cobb 500), and the chickens come from parent flocks raised on the territory of Serbia. Figure 1 shows a map of the province of Vojvodina with marked broiler chicken farms. All analyzed farms have previous cooperation with the Department of Epizootiology, Clinical Diagnostics, and DDD of the Scientific Veterinary Institute "Novi Sad" in the field of poultry health care.

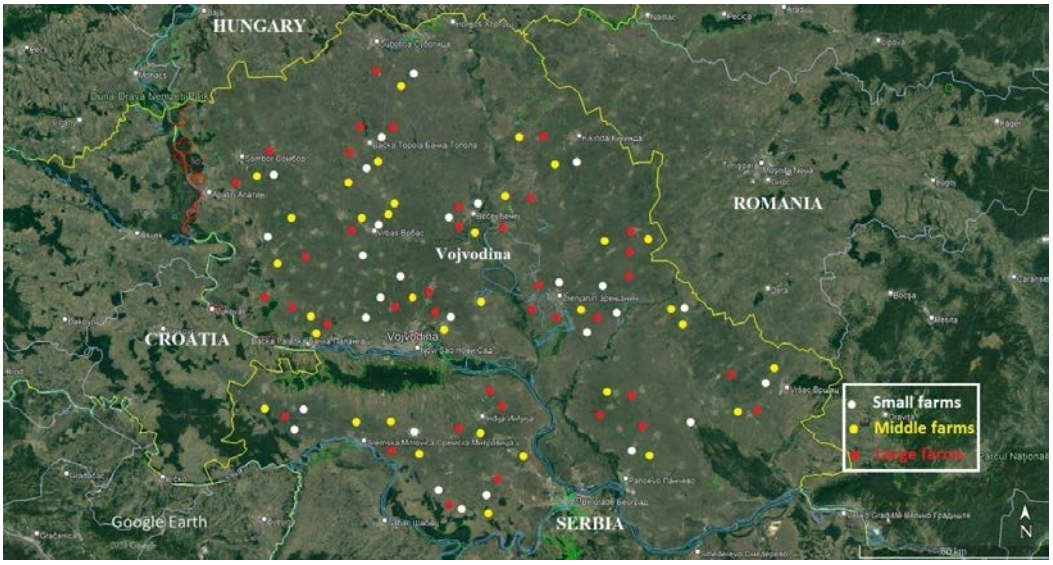

Figure 1. Map of the province of Vojvodina with marked broiler chicken farms

Biosecurity Questionnaire

The Biocheck.UGent scoring system (https://biocheckgent.com/en) was used to quantify farm biosecurity measures according to *Tanquilut et al. (2020).* This risk-based scoring system for on-farm biosecurity quantification is credible, repeatable, and can be validated. The questionnaire aims to describe the complete status of biosecurity measures on the farm. It consists of questions about each relevant aspect of biosecurity to determine whether a preventive measure is being applied or whether a particular health problem is present or absent. The questionnaire is the result of a detailed literal study of disease transmission in poultry, from previous information obtained during the development of the BiocheckUGent tool for pigs. The literature review was performed using the existing literature on disease transmission in poultry. All possible routes of transmission are included, such as airborne, foodborne, vectorial, and environmental. Information on general biosecurity procedures was obtained from the Biocheck.UGent pig tool.

Biosecurity assessment

Assessment of the biosecurity level was carried out by filling in the BioCheck.UGent questionnaire (https://biocheckgent.com/en) on-site, after a visual assessment of the farm. The questionnaire is a risk-based scoring system that objectively estimates on-farm biosecurity, resulting in a farm-specific report that assesses external (all measures that prevent the introduction of pathogens to the farm) and internal biosecurity (all measures taken to prevent spread within the farm). It includes 97 dichotomous or trichotomous questions that are divided into several subcategories for external and internal biosecurity. Each subcategory consists of 2 to 19 questions. The overall farm biosecurity level is a weighted average of the external and internal biosecurity scores. Scores range from 0 to 100, with the last being the implementation of all biosecurity measures, indicating farmers' compliance with high biosecurity standards. To prevent interviewer bias, the questionnaire was completed during or after the farm visit.

Reporting of the Biosecurity Level

Based on the answers given in the questionnaire, the farmer receives a score between 0 and 100 for external and internal biosecurity and the corresponding subcategories. Immediately after completing the questionnaire, which takes between 20 and 30 minutes, all the results of the different

subcategories are calculated online and displayed in a table together with the average results in the world (Figure 2). This allows the farmer to compare the obtained results with his colleagues. If the obtained result deviates from 100, it indicates a potential scope for improvement. The results obtained are also graphically displayed on a spider web graph (Figure 3), enabling quick visual identification of any biosecurity risks on the farm. The blue geometric figure represents the average size of external or internal biosecurity in a broiler farm (Figure 3).

Subcategory	Your score	World average
External biosecurity		
A. Purchase of one-day-old chicks	47 %	63 %
B. Depopulation of broilers (slaughterhouses, traders, individuals)	37 %	57 %
C. Feed and water	46 %	56 %
D. Removal of manure and carcasses	45 %	55 %
E. Visitors and farmworkers	80 %	68 %
F. Material supply	100 %	68 %
G. Infrastructure and biological vectors	78 %	76 %
H. Location of the farm	42 %	65 %
Subtotal External biosecurity	**60 %**	**64 %**
Internal biosecurity		
I. Disease management	72 %	76 %
J. Cleaning and disinfection	55 %	65 %
K. Materials and measures between compartments	82 %	72 %
Subtotal Internal biosecurity	**67 %**	**70 %**
Total	**62 %**	**66 %**

Figure 2. Presentation of the results of the survey on biosecurity

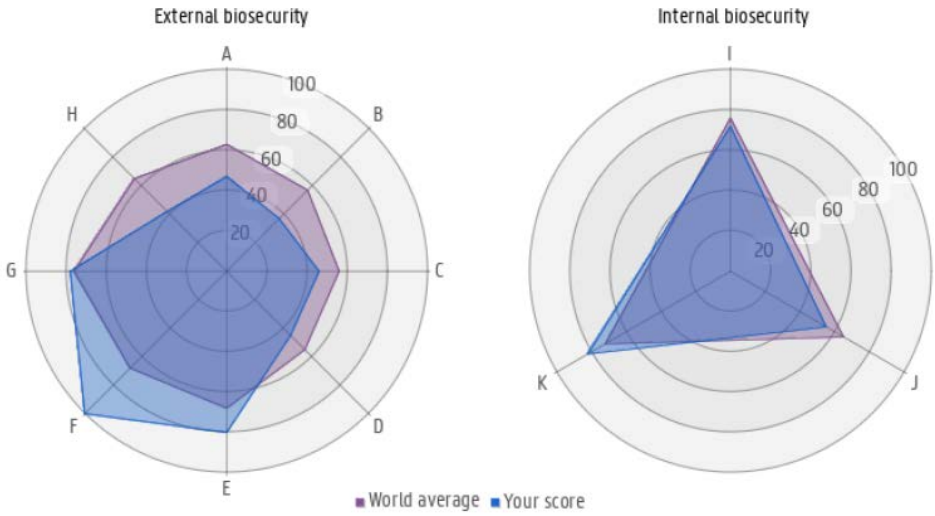

Figure 3. Graphic presentation of observed biosecurity measures on the farm

Statistical analysis

The data collected using the questionnaire were analyzed with descriptive statistics (frequency and mean value). Due to the small (limited) number of broiler farms that participated in the study and therefore the limited data set, the statistical analysis was narrowed down to descriptive statistics.

Results and Discussion

As already described in the previous section, the scoring system for biosecurity is divided into 2 categories (external and internal biosecurity) and 11 subcategories.

The results of the analysis of external and internal biosecurity measures on large-size farms are shown in Table 1. The data show that most farms implement measures at a level that is below the average in our country, and also below the world average (Table 1). The lowest overall level of biosecurity was obtained on farm III (53/100), while the best was on farm II (64/100). The overall level of biosecurity on all farms was below the world average and the average in our country (Table 1). The best level of external biosecurity was established on farm II (above the world and average of our country), and internally on farm I (still below

the world and average of our country). The average values of external, internal, and total biosecurity on all farms were below the world and national level.

Table 1. Presentation of biosecurity assessment (internal and external) on large-size farms

Farms	Type	External biosecurity	Country average	World average	Internal biosecurity	Country average	World average	Total biosecurity	Country average	World average
Farm I	Large	60%	65%	64%	62%	65%	70%	62%	65%	66%
Farm II	Large	69%	65%	64%	51%	65%	70%	64%	65%	66%
Farm III	Large	58%	65%	64%	40%	65%	70%	53%	65%	66%
Farm IV	Large	62%	65%	64%	50%	65%	70%	58%	65%	66%
Farm V	Large	64%	65%	64%	40%	65%	70%	57%	65%	66%
Average		**63%**	**65%**	**64%**	**49%**	**65%**	**70%**	**59%**	**65%**	**66%**

The analysis of the biosecurity questionnaire on middle-size farms also showed a difference from the world and the average of our country (Table 2). The average level of biosecurity of all five farms is below the world and national level. The data on external biosecurity were below the world and national level, so farm X had the highest level of biosecurity (61/100), and farm VI had the lowest (26/100). Internal biosecurity was also highest on farm X (62/100) and lowest on farm VII (20/100). The average data on internal biosecurity are also below world and national levels. Overall biosecurity was highest on farm X (61/100) and lowest on farm VII (25/100).

Table 2. Presentation of biosecurity assessment (internal and external) on middle-size farms

Farms	Type	External biosecurity	Country average	World average	Internal biosecurity	Country average	World average	Total biosecurity	Country average	World average
Farm VI	Middle	26%	65%	64%	29%	65%	70%	27%	65%	66%
Farm VII	Middle	27%	65%	64%	20%	65%	70%	25%	65%	66%
Farm VIII	Middle	46%	65%	64%	53%	65%	70%	48%	65%	66%
Farm IX	Middle	39%	65%	64%	45%	65%	70%	41%	65%	66%
Farm X	Middle	61%	65%	64%	62%	65%	70%	61%	65%	66%
Average		**40%**	**65%**	**64%**	**42%**	**65%**	**70%**	**40%**	**65%**	**66%**

On small-size farms, the results of the biosecurity questionnaire showed lower level compared to the world and national average (Table 3). The highest level of biosecurity was established on farm XII (62/100), and the lowest on farm XV (38/100). The average level of total biosecurity was lower compared to the world and average of our country. Farm XII also had the highest level of internal biosecurity (72/100), which was above the world and national average. In the

assessment of external biosecurity, the highest result was also observed at farm XII (57/100), however, it was below the world and average of our country.

Table 3. Presentation of biosecurity assessment (internal and external) on small-size farms

Farms	Type	External biosecurity	Country average	World average	Internal biosecurity	Country average	World average	Total biosecurity	Country average	World average
Farm XI	Small	38%	65%	64%	66%	65%	70%	46%	65%	66%
Farm XII	Small	57%	65%	64%	72%	65%	70%	62%	65%	66%
Farm XIII	Small	47%	65%	64%	53%	65%	70%	49%	65%	66%
Farm XIV	Small	39%	65%	64%	56%	65%	70%	44%	65%	66%
Farm XV	Small	36%	65%	64%	44%	65%	70%	38%	65%	66%
Average		**43%**	**65%**	**64%**	**58%**	**65%**	**70%**	**48%**	**65%**	**66%**

Although data collection using questionnaires often presents an analysis of implemented biosecurity measures in a subjective way (from the farmer's point of view), questionnaires have proven to be a useful tool for assessing biosecurity on poultry farms and a potential initiator for improving measures *(Tilli et al., 2022).* The results of our study showed a low level of implementation of internal and external biosecurity on all farms. Data on applied biosecurity measures on all three categories of farms were obtained using a quantitative tool in a standardized and reproducible way. To avoid the possibility of an unrealistic presentation of the current biosecurity, on each farm after the analysis and assessment, the examiner filled out a questionnaire. Given that in our country there is no official data on the level of applied biosecurity measures on broiler chicken farms, this study showed real differences between farms of different capacities. The Biocheck.UGent scoring system allows us to quantify biosecurity at the flock level, taking into account all relevant aspects of biosecurity *(Gelaude et al., 2014).* This scoring system can be considered a useful tool for monitoring the biosecurity level of broiler farms over time. In this way different poultry farms can be easily compared with each other and each farm can be more easily monitored when using the same scoring system. With this quantitative analysis, we study the relationship between biosecurity, health, and production characteristics, as is also carried out in pig farms *(Laanen et al., 2013).*

In large-size farms, internal biosecurity was lower than external biosecurity, which is very similar to data from pig farms *(Laanen et al., 2013).* However, the situation in the other two categories of farms was reversed. Internal biosecurity was at a higher level than external. This can be explained by the greater number of applied internal biosecurity measures, as well as the fact that these measures are influenced to the greatest degree by the grower himself *(Gelaude et al., 2014).* In our study, the level of farmers' awareness of the importance of

biosecurity measures on the surveyed farms was low, mostly in the case of farms with small and middle-size. This could be explained by the fact that most of these farmers were not trained in poultry farming *(De Paul Tatfo Keutchatang et al., 2021)*. Biosecurity oversight often occurs on these farms, and they are considered high-risk. On such farms, contact with an expert (veterinarian, agricultural engineer) occurs only when a health problem appears on the farm *(De Paul Tatfo Keutchatang et al., 2021).* Large-size farms usually have an employed veterinarian, or they engage him to monitor the health of the flock. This could be a key reason for better biosecurity measures about meddle and small-size farms *(Kouam et al., 2018).*

Biosecurity measures are not always economically acceptable, but they pay off in the long term due to disease prevention *(Dorea et al., 2010).* This includes the costs of equipment for installing biosecurity barriers as well as the time spent by farm staff during the implementation of these measures *(Sibanda et al., 2018).*

Collected data from all three categories of farms revealed deficiencies in biosecurity. Encouraging farmers and veterinarians to use biosecurity quantification tools can help identify and quantify biosecurity risks on farms. Their continued use and development can improve efficiency in dealing with biosecurity risks. For biosecurity on farms to be constantly maintained at a high level, constant communication and cooperation between farmers and experts (veterinarians, agricultural engineers) is needed, to remove all potential risks in time.

Conclusion

The findings from this study suggest that the control of implemented biosecurity measures in broiler farms of different capacities is very important. The results show that the current level of biosecurity measures is below average compared to the level of biosecurity at the global and local levels. Most of the biosecurity risks for chicken farms originate from inappropriate site selection, purchase of day-old chicks of unknown quality, and lack of procedures and training of farm employees. The effect of this research should be the development of a biosecurity plan, finding risks, and the appropriate way to educate farm owners, as well as farm employees, about the implementation of biosecurity measures.

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