



Transitioning to a risk-based approach in pork inspection in Serbia: are we ready for *Trichinella* control reform?

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ABSTRACT

The implementation of risk-based approaches in meat inspection is a key step toward modernizing food safety systems in accordance with international standards. In Serbia, national Regulation 48/2022 introduced the possibility of designating pig farms as “*Trichinella*-free”, thereby allowing for reduced testing—only 10% of pigs from such farms are required to undergo routine post-mortem *Trichinella* inspection. However, three years after its adoption, no farm in Serbia has officially obtained this status. This paper critically examines the legal and institutional framework surrounding the application of Regulation 48/2022, with a focus on the readiness of the veterinary system, the level of awareness among stakeholders, and the practical challenges to implementation.

In addition to the regulatory and veterinary aspects, this study also incorporates findings from slaughterhouse-level inquiries. Slaughterhouse operators report that, regardless of official *Trichinella*-free status, they would still prefer to inspect every pig carcass, fearing the legal and reputational consequences of potential oversight. This undermines the core principle of the regulation and reflects a gap between policy design and its real-world acceptance. Special attention is given to the public health implications of *Trichinella* control, as well as the potential benefits and risks of transitioning to a selective inspection model. The analysis suggests that although the regulatory framework is formally aligned with EU practices, significant barriers—including institutional inertia and distrust—remain that hinder its practical application. The paper concludes with recommendations for improving stakeholder engagement, capacity building, and confidence in surveillance systems as prerequisites for a successful shift toward risk-based *Trichinella* control in Serbia.

1. Introduction

Trichinellosis is among the most widespread zoonotic parasitic diseases globally. Human infection occurs through the consumption of raw or undercooked pork meat containing larvae of nematodes

belonging to the genus *Trichinella*. In many countries, individual carcass inspection for pigs at slaughter is mandatory; however, such measures entail significant costs, particularly given the low incidence of positive cases in pigs raised under controlled housing conditions (Frenssen et al., 2017).

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Serbia has aligned its national legislation (No. 48/2022; *RS Regulation*, 2022) with European Union Regulation 2015/1375 (*EU Regulation*, 2015), which mandates control measures for the detection of *Trichinella* spp. in meat from pigs and other susceptible domestic and wild animals to protect public health. All pigs slaughtered for commercial purposes must be tested for *Trichinella*, unless they originate from controlled housing systems that comply with stringent biosecurity requirements (e.g., rodent control, prohibition of feeding with animal by-products, and prevention of contact with wildlife) and have been officially approved by the competent authority.

Even under such controlled systems, it is required that at least 10% of pigs from each farm be tested annually to verify the *Trichinella*-free status. Detection is performed using the standard artificial digestion method of muscle tissue (most commonly the diaphragm pillars), which involves the use of pepsin and hydrochloric acid to release larvae from the tissue. This method is considered the reference standard due to its high sensitivity and reliability, while alternative methods can be used only if they are properly validated and officially approved.

These regulatory measures are grounded in risk-based principles, with a strong focus on the prevention of infection at the primary production level, official controls at slaughterhouses, laboratory accreditation, and mandatory traceability of products of animal origin. This integrated approach ensures systematic control and minimizes the risk of human trichinellosis through consumption of contaminated meat (*RS Regulation*, 2022; *EU Regulation*, 2015).

In both Serbia and the European Union, human trichinellosis is a notifiable disease subject to mandatory reporting. In Serbia, a total of 2,922 cases were reported between 2001 and 2022, corresponding to an incidence rate of 38.94 per 100,000 inhabitants. The average annual number of registered cases during this period was 133, ranging from a peak of 577 cases in 2002 to zero cases reported in 2021. A statistically significant downward trend in the incidence rate of trichinellosis has been observed since 2004 (*Plavša et al.*, 2023).

Similarly, a clear reduction in human trichinellosis cases has been documented across the European Union over the past decade, with a decline of more than 85% compared to 2014, as illustrated in Figure 1 (*ECDC*, 2016; 2017; 2018; 2023).

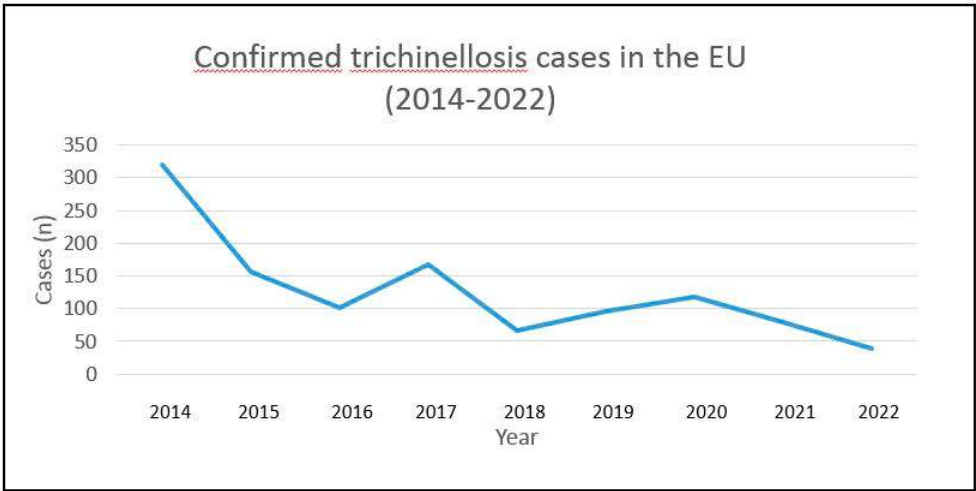


Figure 1. Trend of reported trichinellosis cases in the EU in the period from 2014 to 2022

2. Reform of trichinella control in serbia

Serbia harmonized its national Regulation (48/2022; *RS Regulation*, 2022) with *EU Regulation* (2015) three years ago. According to data obtained from the Veterinary Directorate of Serbia, no farm has yet been granted *Trichinella*-free status (personal communication).

To assess stakeholder awareness and the implementation of the new regulatory requirements, a survey was conducted among nine slaughterhouses in Serbia that process pigs. While the results offer valuable preliminary insights into industry perceptions and practices, the sample is relatively small and not representative of the entire slaughterhouse sector. Future studies should aim to expand the research

Table 1. Survey questions for slaughterhouses on awareness and implementation of Regulation 48/2022 (*RS Regulation*, 2022).

Question	Answer options	Number of slaughterhouses (N=9)	Percentage (%)
1. Are you familiar with the amended legal regulation 48/2022 regarding <i>Trichinella</i> inspection?	1) Yes 2) No	7/9 2/9	77.8% 22.2%
2. Are you aware of the key changes introduced by the new regulation?	1) Yes 2) No	3/9 6/9	33.3% 66.7%
3. When evaluating your suppliers, do you consider whether the farm is certified as <i>Trichinella</i> -free?	1) Yes 2) No	0/9 9/9	/ 100%
4. If a farm is certified as <i>Trichinella</i> -free, would you in the future test only 10% of pigs from that farm?	1) 10% 2) 100%	0/9 9/9	/ 100%

across a wider geographic area and include a larger number of facilities, to ensure more robust and comprehensive findings.

The survey results indicate that although the majority of slaughterhouses (77.8%) is aware of Regulation 48/2022, only one-third (33.3%) understands the key changes it introduces. This discrepancy highlights a lack of adequate information and understanding of the regulatory framework, which could hinder its effective implementation.

None of the slaughterhouses consider the *Trichinella*-free status of farms when evaluating their suppliers, further confirming that the concept of selective testing has not yet been adopted in practice. Moreover, all respondents (100%) stated that even if a farm were officially certified as *Trichinella*-free, they would still continue to test every pig carcass, despite the regulation allowing for 10%-sample testing.

This practice reflects a deep-rooted mistrust in the certification system and concerns about the potential legal consequences of missing an infection. As a result, the core objective of the regulation—transitioning to risk-based inspection—is effectively undermined.

While the current findings offer a preliminary understanding of the challenges in implementing risk-based *Trichinella* control in Serbia, the limited number of surveyed slaughterhouses (N=9) is a study limitation. Broader, nationwide surveys would be necessary to more accurately assess the level of

readiness across the sector and identify regional variations in awareness and implementation.

3. Conclusion

Although Regulation 48/2022 in the Republic of Serbia (*RS Regulation*, 2022) has been formally harmonized with Regulation 2015/1375 (*EU Regulation*, 2015), its practical implementation reveals significant shortcomings. The absence of farms certified as *Trichinella*-free, even three years after the regulation came into force, along with the low level of awareness among slaughterhouses regarding the legislative changes, highlights the need to strengthen communication and education across all stakeholders in the pork production chain.

The prevailing practice of testing all pigs—including those from farms that could potentially qualify for *Trichinella*-free status—reflects a deep-rooted lack of trust in the certification system and concerns about reputational or legal consequences in the case of failure. To meet the intended objectives of the regulation and build confidence in the risk-based model, it is essential to enhance institutional support through targeted education, transparent communication, and system-level reforms that facilitate consistent application of the law.

Further research involving a larger and more geographically diverse sample of slaughterhouses is recommended to validate these findings and inform national-level policy.

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References

- EU Regulation, (2015). Commission Regulation 2015/1375, (2015). EU 2015 Commission Regulation 2015/1375 laying down specific rules on official controls for *Trichinella* in meat.
- European Centre for Disease Prevention and Control (ECDC), (2016). *Trichinellosis – Annual Epidemiological Report for 2014 data*. [online] Available at: <https://www.ecdc.europa.eu/en/publications-data/trichinellosis-annual-epidemiological-report-2016-2014-data> [Accessed 8 Jul. 2025].
- European Centre for Disease Prevention and Control (ECDC), (2017). *Trichinellosis – Annual Epidemiological Report 2016*. [online] Available at: <https://www.ecdc.europa.eu/en/publications-data/trichinellosis-annual-epidemiological-report-2016> [Accessed 8 Jul. 2025].
- European Centre for Disease Prevention and Control (ECDC), (2018). *Trichinellosis – Annual Epidemiological Report 2017*. [online] Available at: <https://www.ecdc.europa.eu/en/publications-data/trichinellosis-annual-epidemiological-report-2017> [Accessed 8 Jul. 2025].
- European Centre for Disease Prevention and Control (ECDC), (2023). *Surveillance and disease data for Trichinellosis*. [online] Available at: <https://www.ecdc.europa.eu/en/trichinellosis/surveillance-and-disease-data> [Accessed 8 Jul. 2025].
- Franssen, F., Swart, A., van der Giessen, J., Havelaar, A., Takumi, K. (2017). Parasite to patient: A quantitative risk model for *Trichinella* spp. in pork and wild boar meat. *International Journal of Food Microbiology*, 16(241), 262–275. doi: 10.1016/j.ijfoodmicro.2016.10.029. Epub 2016 Oct 26. PMID: 27816842
- Plavša, D., Šaponjić, V., Milinković, M., Dimitrijević, D., Čosić, J., Milić, M. (2023). Trihinelozu u Srbiji u periodu od 2001. do 2022. godine. *Glasnik javnog zdravlja*. 97(3), 261–271. doi: 10.5937/serbjph2303261P
- RS Regulation—Republic of Serbia, (2022). *Regulation on the method of official control of animals before and after slaughter for the presence of Trichinella in meat*. *Official Gazette of the Republic of Serbia*, No. 48/2022

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