

COMBINED USE OF METHODS FOR TESTING MEAT PRODUCTS FOR *SALMONELLA* SPP.

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Abstract. *This literature-based review examines the theoretical basis for combining bacteriological methods and the polymerase chain reaction (PCR) to detect Salmonella spp. in meat products. It considers the ability of bacteriological methods to recover viable cultures and the role of PCR in obtaining preliminary information more rapidly. The functions of sample preparation, evaluation of quality controls, and systematic recording of results within the analytical workflow are summarized. Parallel testing, assessment of turnaround time, and evaluation of agreement between results are proposed for a future comparative study.*

Keywords: *Salmonella spp., meat products, bacteriological method, PCR, viable culture, quality control, testing algorithm.*

Аннотация. *В настоящем обзоре, основанном на анализе литературы, рассматриваются теоретические основы совместного применения бактериологических методов и полимеразной цепной реакции (ПЦР) для выявления Salmonella spp. в мясных продуктах. Обсуждаются возможности бактериологических методов выделять жизнеспособные культуры и роль ПЦР в более оперативном получении предварительной информации. Обобщено значение пробоподготовки, оценки результатов контроля качества и систематической регистрации результатов в процессе лабораторного анализа. Для будущего сравнительного исследования предлагаются параллельное*

проведение испытаний, оценка времени получения результатов и степени согласованности результатов двух методов.

Ключевые слова: *Salmonella spp., мясные продукты, бактериологический метод, ПЦР, жизнеспособная культура, контроль качества, алгоритм исследования.*

Annotatsiya. *Adabiyotlar tahliliga asoslangan ushbu sharhda go'sht mahsulotlarida Salmonella spp. ni aniqlash uchun bakteriologik usullar va polimeraza zanjir reaksiyasini (PZR) birgalikda qo'llashning nazariy asoslari ko'rib chiqiladi. Bakteriologik usullarning yashovchan kulturalarni ajratib olish imkoniyati hamda dastlabki ma'lumotlarni tezroq olishda PZRning o'rne yoritiladi. Laboratoriya tahlili jarayonida namunalarni tayyorlash, sifat nazorati natijalarini baholash va tahlil natijalarini muntazam qayd etishning ahamiyati umumlashtiriladi. Kelgusida o'tkaziladigan qiyosiy tadqiqot uchun tekshiruvlarni parallel olib borish, natija olishga sarflanadigan vaqtni hamda ikki usul natijalarining o'zaro moslik darajasini baholash taklif etiladi.*

Kalit so'zlar: *Salmonella spp., go'sht mahsulotlari, bakteriologik usul, PZR, yashovchan kultura, sifat nazorati, tekshiruv algoritmi.*

Introduction. Obtaining reliable results promptly is important when testing meat products for *Salmonella* spp. Laboratory findings provide a basis for assessing the microbiological safety of a product. Method selection should therefore consider both turnaround time and the ability to confirm the detected microorganism. Bacteriological testing involves growing *Salmonella* on culture media, isolating a pure culture, and identifying it using appropriate characteristics. It enables recovery of viable bacterial cultures but requires time because the examination comprises several successive stages [1]. The polymerase chain reaction (PCR) can provide preliminary information more rapidly by detecting

Salmonella-specific DNA sequences [2]. Combining these methods helps integrate their capabilities into a common analytical workflow. This work aims to describe literature-based considerations for the combined use of bacteriological testing and PCR in the detection of *Salmonella* spp. in meat products and to identify evaluation criteria for a future comparative study.

Materials and Methods. The study was conducted as a narrative literature review. GOST 31659-2024 was used to examine the methodological basis of bacteriological testing. The potential of PCR in food and meat samples was reviewed using the studies by Malorny et al. and Fachmann et al. [1–3].

The sources were examined through comparative analysis and synthesis of published evidence. The analysis focused on sample preparation, detection principles, preliminary results, recovery of viable cultures, and recording of outcomes. Based on these findings, a theoretical sequence for parallel bacteriological and PCR testing was developed. Turnaround time, agreement between results, and the need for repeat testing were selected as the main criteria for future evaluation. No new laboratory experiments were conducted.

Results. The literature review showed that bacteriological testing and PCR serve different functions within the analytical workflow. Under GOST 31659-2024, conventional detection includes pre-enrichment, selective enrichment, isolation of colonies on selective media, and biochemical and serological confirmation [1]. This sequence is used to isolate bacteria from the product and confirm their assignment to the genus *Salmonella*. The detection capability of PCR is based on identifying *Salmonella*-specific DNA. The study by Malorny et al. in food samples demonstrated the potential of real-time PCR to reduce

turnaround time [2]. Fachmann et al. highlighted the importance of sample preparation for rapid detection in meat [3]. Thus, overall turnaround time includes enrichment where required and DNA extraction, as well as the PCR reaction itself. For a comparative study, the proposed sequence begins with recording the product type and the amount to be tested, followed by sample preparation according to the applicable requirements. Bacteriological and PCR tests are performed on comparable parallel test portions. Conventional testing follows GOST 31659-2024, while PCR follows the instructions for the selected assay. Results are entered into a common record after the quality controls for each method have been evaluated. The record should include the sample code, product type, amount examined, method used, control status, final result, and testing duration. The time to obtain a preliminary PCR result and the time to complete bacteriological confirmation should be recorded separately. This allows comparison of the methods in terms of both positive or negative outcomes and the speed at which information becomes available. In the proposed parallel comparative study, a negative PCR result is not used as a criterion for stopping bacteriological testing. Completing both examinations is necessary to assess agreement and to investigate discordant findings separately.

Discussion. When bacteriological testing and PCR are combined, the function of each stage must be clearly defined. PCR provides preliminary molecular information, whereas bacteriological testing recovers viable cultures and confirms their identity. Results from the two methods should therefore be interpreted according to the information each provides. Detection of DNA by PCR does not provide exactly the same information as recovery of a viable culture. Improving a testing algorithm requires examination of the entire process, from sample

receipt to the final report. Identifying the stages that take the most time, the point at which preliminary information becomes available, and the circumstances requiring repeat testing enables improvements to be selected on a sound basis. Control validity and completion of confirmation are important alongside speed. Parallel testing primarily generates data for comparison of the methods. Its use in routine laboratory practice depends on the requirements for the relevant product and selected method. Adding PCR therefore does not establish a general rule allowing all PCR-negative samples to be excluded from bacteriological examination.

The studies by Malorny et al. and Fachmann et al. demonstrate the potential of PCR for rapid detection, but their results apply to specific sample preparation and testing conditions [2, 3]. Future work should evaluate the overall turnaround time, agreement between results, and additional workload for the selected meat products. Conclusions about reductions in time or cost should be based on these measurements.

Conclusion. Combining PCR and bacteriological testing for *Salmonella* spp. in meat products brings together rapid molecular information and recovery of viable cultures. Sample preparation, testing procedures, evaluation of quality controls, and recording of results must be organized consistently. Parallel use of the two methods in a future comparative study can help assess turnaround time, agreement between results, and the need for repeat testing. These data can provide a theoretical and practical basis for improving the testing algorithm. The effectiveness of the proposed sequence should be established through appropriate laboratory studies.

References

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