

Policy Brief

13/09/2025



qPCR as a National Strategy for Preventing Meat Adulteration

Informative

Written by Alfi Sophian

13/09/2025



qPCR as a National Strategy for Preventing Meat Adulteration

Written by Alfi Sophian

Problem

Meat adulteration occurs when cheaper or undeclared animal species are mixed with premium meat products, misleading consumers and violating labeling laws. Such practices pose risks to consumer health, including allergen exposure, and compromise religious and ethical dietary requirements. Traditional methods for species identification, such as protein-based or microscopic analysis, often fail when applied to heat-treated or highly processed meat products. This limitation allows fraudulent practices to go undetected, eroding public trust and harming the reputation of domestic producers. Moreover, undetected adulteration can trigger international trade disputes and lead to costly product recalls. Many testing laboratories still rely on slow and outdated techniques, with inconsistent results across regions. The lack of a standardized, molecular-based surveillance system further complicates enforcement actions. Without a robust national framework, enforcement agencies face difficulty in detecting, tracing, and prosecuting meat fraud cases in a timely manner. Implementing qPCR as a national strategy offers a timely, accurate, and scalable solution to address this growing problem and strengthen food authenticity assurance.

Summary point

Meat adulteration remains a critical challenge to food safety, consumer trust, and international trade compliance. Real-time polymerase chain reaction (qPCR) provides a powerful, rapid, and highly sensitive method to detect species-specific DNA in meat products, making it ideal for preventing fraud and ensuring authenticity. Unlike conventional tests, qPCR can identify trace amounts of undeclared meat even in highly processed products. National adoption of qPCR as a routine monitoring tool will enhance surveillance of meat supply chains, protect religious dietary compliance (e.g., halal and kosher), and improve market transparency. Strengthening laboratory capacity, standardizing protocols, and integrating qPCR data into food safety information systems will create a more resilient and trustworthy food system.

Key messages

- qPCR enables rapid and sensitive detection of meat adulteration.
- Adoption supports consumer protection and religious dietary compliance.
- Standardization ensures consistent, reproducible, and legally defensible results.
- Integration into surveillance systems strengthens national food security.
- Capacity building and training are essential for sustainable implementation.

Notes

qPCR works by amplifying target DNA sequences unique to each animal species, allowing detection of adulterants at very low concentrations. Its high specificity and multiplexing capability enable simultaneous testing for several species in a single run, improving efficiency. The technique is suitable for raw and processed products, making it ideal for complex food matrices. However, its reliability depends on validated primers, standardized operating procedures, and trained personnel. Sustainable implementation requires investment in laboratory infrastructure, inter-laboratory proficiency testing, and clear regulatory guidelines. When applied systematically, qPCR becomes a cornerstone for modern meat authenticity surveillance programs.

Recommendations

The adoption of qPCR should be prioritized as a national strategy to modernize meat authenticity monitoring. Governments must invest in laboratory infrastructure, procurement of high-quality equipment, and development of validated qPCR assays for priority species. Regulatory agencies should issue clear guidelines on sampling, testing, and result interpretation to ensure harmonization across laboratories. Capacity-building programs must be launched to train and certify personnel in molecular diagnostics.

Recommended Actions:

- Develop and publish national qPCR testing standards.
- Create a central database for meat authenticity results.
- Ensure equitable resource distribution for regional laboratories.
- Support research on emerging adulteration trends and novel targets.
- Foster collaboration between government, academia, and industry for technology transfer

Implications

Implementing qPCR as a standard tool for meat authentication will significantly reduce undetected fraud, protect consumer rights, and enhance transparency across the supply chain. By minimizing adulteration, qPCR safeguards religious dietary compliance, reducing social and economic tensions. Reliable molecular data will also strengthen regulatory enforcement and support prosecution of food fraud cases. Internationally, it will help meet export requirements and boost competitiveness of domestic meat producers. Furthermore, integrating qPCR data into national food safety information systems allows early warning of fraud trends and informs risk-based inspections. Failure to adopt such technology risks continued public distrust, trade disputes, and economic losses from product recalls.

Conclusion

qPCR is a transformative technology for preventing meat adulteration and protecting consumer trust. Its adoption as a national strategy will modernize surveillance, ensure fair trade, and strengthen compliance with domestic and international standards. Strategic investment in infrastructure, personnel training, and regulatory frameworks is essential for achieving lasting improvements in food authenticity assurance.

Reference

- FAO/WHO. (2021). *Applications of Molecular Tools in Food Safety Risk Management*.
- Codex Alimentarius Commission. (2020). *General Principles of Food Hygiene CXC 1-1969*.
- Sophian, A. (2021). Short Communication: Analysis of purity and concentration of extracted DNA on salted fish processed food products. *Asian Journal of Natural Product Biochemistry*, 19(1). <https://doi.org/10.13057/biofar/f190104>
- Sophian, A., Purwaningsih, R., Muindar, M., Igrisa, E. P. J., & Amirullah, M. L. (2021). Short Communication: Analysis of purity and concentration of DNA extracted from intron patho gene-spin extraction on crab processed food product samples. *Asian Journal of Tropical Biotechnology*, 18(1). <https://doi.org/10.13057/biotek/c180103>
- Sophian, A., & Syukur, A. (2021). Analysis of Purity and Concentration of Isolated DNA in Making Raw DNA of Rat Species. *Eruditio : Indonesia Journal of Food and Drug Safety*, 1(2), 1–5. <https://doi.org/10.54384/eruditio.v1i2.75>
- Sophian, A., & Yustina, Y. (2023). Analisis Nilai Kemurnian DNA Menggunakan Nano Fotometer pada Rasio 260/230 yang Diisolasi dari Produk Nugget. *Muhammadiyah Journal of Nutrition and Food Science (MJNF)*, 3(2), 82. <https://doi.org/10.24853/mjnf.3.2.82-86>
- Sophian, A., Sri, U., & Sofia, U. D. (2022). DNA isolation in processed chicken meat products (nugget) using modified DNeasy Mericon Food kit (Qiagen). *HO CHI MINH CITY OPEN UNIVERSITY JOURNAL OF SCIENCE - ENGINEERING AND TECHNOLOGY*, 12(2), 15–21. <https://doi.org/10.46223/hcmoujs.tech.en.12.2.2463.2022>
- Sophian, A. (2021). Species DNA Detection Using PGR Gene Genetic Markers in Chicken Nuggets. *Indonesian Food Science & Technology Journal*, 5(1), 17–20. <https://doi.org/10.22437/lfstj.v5i1.14618>
- Sophian, A. (2021). Detection of Species DNA in Chicken Meatball Products Using NGF Genes as Molecular Markers. *BiosciED: Journal of Biological Science and Education*, 2(2), 47–51. <https://doi.org/10.37304/bed.v2i2.3422>
- Sophian, A., Utaminingsih, S., Yenita, Y., & Purwaningsih, R. (2024). Detection of Species DNA in Chicken Meat Processed Food Products Using GH (Growth Hormone) Genes as Molecular Markers. *Food Scientia: Journal of Food Science and Technology*, 4(1), 63–71. <https://doi.org/10.33830/fsj.v4i1.6358.2024>
- Utaminingsih, S., Utami, S. D., & Sophian, A. (2022). Isolasi DNA pada produk otak-otak ikan bandeng. *Muhammadiyah Journal of Nutrition and Food Science (MJNF)*, 3(1), 36–41.
- Utaminingsih, S., & Sophian, A. (2022). Analysis of purity and concentration of DNA isolation results on chondroitin samples. *BiosciED: Journal of Biological Science and Education*, 3(2), 56–61.
- Utami, S. D., Utaminingsih, S., & Sophian, A. (2023). Analisis DNA Hasil Isolasi Pada Produk Pangan Olahan Ikan (Surimi Ikan) Menggunakan Nano Photometer. *JRST (Jurnal Riset Sains dan Teknologi)*, 7(1), 9–13.
- Wulan, D. T., Sutanta, M., & Sophian, A. (2021). Comparison of two commercial DNA extraction kit to obtain high quality porcine DNA. *Asian Journal of Tropical Biotechnology*, 18(2).