UNIWERSYTET
WARMIŃSKO-MAZURSKI W OLSZTYNIE

WYDZIAŁ NAUKI O ŻYWNOŚCI
KATEDRA MLECZARSTWA I ZARZĄDZANIA JAKOŚCIĄ

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DOCTORAL DISSERTATION REVIEW

The doctoral dissertation submitted by **MSc. Aparna Porumpathuparambam Murali**, entitled "**Assessment of ensuring food safety among stakeholders of organic food products**" was prepared in the discipline of food technology and nutrition, within the field of agricultural sciences, under the supervision of Prof. Joanna Trafiałek, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences.

1. Formal and Legal Basis for the Review

Formal basis for the review: Resolution No. 66/TŻiŻ-2025/2026 of the Discipline Council of Food Technology and Nutrition of the Warsaw University of Life Sciences of 17th April 2026.
Legal basis of the review: The Act of 20 July 2018 – Law on Higher Education and Science (Journal of Laws of 2024, item 1571, as amended) and Resolution No. 89-2022/2023 of the Senate of the Warsaw University of Life Sciences of 26 June 2023 adopting the Regulations governing proceedings for the award of doctoral degrees at the Warsaw University of Life Sciences.

2. Formal Evaluation of the Dissertation

The doctoral dissertation submitted for review by MSc. Aparna Porumpathuparambam Murali, consist of a thematically coherent series of four original peer-reviewed scientific publications, bearing the common title "Assessment of ensuring food safety among stakeholders of organic food products", accompanied by a synthetic summary and statements specifying the contribution of the co-authors.

The publications included in the scientific achievement are as follows:

- P1. Murali AP, Trząskowska M, Trafialek J. Microorganisms in Organic Food—Issues to Be Addressed. Microorganisms. 2023; 11(6):1557. https://doi.org/10.3390/microorganisms11061557 (Ministry Points: 40, IF: 4.1);
- P2. Murali AP, Trafialek J, Trząskowska M, Mazurek-Kusiak AK, Kolanowski W. Food Safety Risk Assessment Based on HACCP Audit Results Using the FMEA Method in Indian Organic Food Processing Plants. Current Nutrition & Food Science. 21:1-15. doi:10.2174/0115734013415006250904112146 (Ministry Points: 20, IF: 0.8);
- P3: Murali AP, Trafialek J, Nair SS. HACCP compliance in organic food processing industries in India: A statistical study by product type and company size. AIMS Agriculture and Food, 2026, 11(1): 75-94. doi: 10.3934/agrfood.2026005 (Ministry Points: 40, IF: 1.9);
- P4: Murali AP, Kołożyn-Krajewska D, Mancinelli R, Muleo R, Nair SS, Trafiałek J. Sustainability and Compliance in Organic Food Industries: A Comparative Study of India and Italy. Sustainability. 2026; 18(5):2302. https://doi.org/10.3390/su18052302 (Ministry Points: 100, IF: 3.3).

The total number of points according to the current Ministry of Science and Higher Education scoring system is 200 points, and the cumulative Impact Factor is 10.1. All listed publications have been published in scientific journals assigned to the discipline of food technology and nutrition. Within the thematically coherent collection of four articles constituting the basis for applying for the doctoral degree in the discipline of food technology and nutrition, MSc A.P. Murali was the first author of all publications and the corresponding author of three papers. The presented publications are multi-author studies in which the substantive contribution of each co-author was specified. According to the attached statements, the contribution of the Doctoral Candidate included conceptualization, methodology, formal analysis, investigation, data curation, writing (original draft preparation, review and editing), and visualization. Relevant declarations of co-authors were included in the submitted documentation. For a more comprehensive presentation of the Doctoral Candidate's contribution to the preparation of the individual publications, it would also be advisable to specify the percentage contribution of the co-authors.

The submitted dissertation for review is presented in the form of a study comprising 8 parts: 1. Introduction, 2. Justification for Choosing the Topic, 3. Aim and research hypothesis of the doctoral thesis, 4. Materials and methods, 5. Results and discussion, 6. Conclusion, 7. References and 8. Copies of the articles comprising the doctoral thesis and statements from co-

authors. The dissertation is preceded by abstracts in both Polish and English, as well as a list of abbreviations.

In summary, I conclude that the submitted dissertation constitutes an original solution to a scientific problem. It is a coherent study, written correctly and clearly illustrated. The tables and figures presenting the obtained results are legible, and the dissertation as a whole was prepared in accordance with generally accepted standards applicable to doctoral dissertations based on a series of scientific publications.

3. Significance and Importance of the Research Problem

In the dissertation submitted for review, MSc. A.P. Murali addressed an important issue concerning the safety of organic food products, which is particularly relevant in the context of global transformations occurring within contemporary food systems. Worldwide, a dynamic development of the organic food market can be observed, resulting from consumer preferences, as consumers frequently perceive organically produced food as safer and healthier.

Organic food and sustainable agricultural production systems are regarded as important elements supporting the implementation of the Sustainable Development Goals, particularly responsible consumption and production (SDG 12), food security and sustainable agriculture (SDG 2), and health protection (SDG 3). Contemporary global food supply chains are characterized by a high degree of complexity, which increases the risk of food safety hazards occurring at all stages of the supply chain. The relevance of the undertaken topic also results from the differentiated levels of food safety supervision in individual countries, as well as from the non-uniform standards governing food safety control systems worldwide, including those related to organic food products. Despite the ongoing harmonization of international requirements, the effectiveness of food safety supervision remains strongly dependent on the legal, organizational, economic, and technological conditions of individual countries. The significance of the undertaken topic is further reinforced by contemporary global crises, including pandemics, geopolitical conflicts, climate change, and disruptions in international supply chains, which have highlighted the necessity of developing resilient and safe food production and distribution systems. Under conditions of increasing globalization of the organic food market, the assessment of the effectiveness of food safety assurance mechanisms and cooperation among stakeholders responsible for food quality and safety becomes particularly important.

Two countries characterized by different levels of the Human Development Index (HDI) were selected for comparative analyses: India and Italy. The HDI assesses the standard of living

based on three dimensions: health, education, and income. India was classified as a medium-developed country (HDI = 0.685), whereas Italy represented a very highly developed country (HDI = 0.915).

Taking the above into consideration, I regard the selection of the dissertation topic as both timely and well justified. In my opinion, the undertaken research topic is of significant scientific and practical relevance and falls within the scope of the discipline of food technology and nutrition. The research findings may contribute to the improvement of international organic food safety management systems and support the development of sustainable and resilient food systems on a global scale.

4. Substantive Evaluation of the Dissertation

The title of the doctoral dissertation has been formulated correctly, and the issues discussed in the publications listed above, included in the dissertation fully correspond with it.

The aim of the study and the research hypotheses have been formulated correctly; they are coherent and achievable through the well-planned research stages. The aim of the dissertation was to assess the level of food safety assurance among selected stakeholders of the organic sector, with particular emphasis on food safety risk assessment, compliance with the HACCP system in organic food processing enterprises, and the analysis of the relationship between sustainable development and the fulfilment of food safety requirements.

The formulated research hypotheses are substantively correct and correspond with the stated objectives of the study and the scope of the conducted research. They refer to key areas associated with the assessment of organic food safety, including risk identification, the effectiveness of control measures, the influence of enterprise characteristics on the level of compliance with food safety requirements, as well as differences in sustainable development practices among stakeholders in the organic sector. Hypotheses H1 and H2 are descriptive and verifiable in nature, whilst hypotheses H3 and H4 concern relationships and enable comparative analyses between the investigated groups of entities. Hypothesis H4 could be formulated more precisely. The Author does not clearly specify which sustainable practices and which aspects of compliance with food safety requirements were subject to assessment.

The research scope was divided into four stages enabling the achievement of the dissertation objectives and the verification of the research hypotheses. In the first stage, a systematic literature review concerning the identification of microbiological hazards associated with organic food was conducted (P1). The second stage involved the assessment of food safety risk in Indian organic food processing enterprises using HACCP audits and the FMEA method

(P2). In the third stage, factors influencing the level of compliance with HACCP requirements in organic food processing enterprises in India were analysed, taking into account enterprise characteristics and external audit results (P3). The final stage of the research involved a comparative assessment of food safety principles, quality management and sustainability practices among stakeholders in the organic food market in Italy and India (P4).

The research material comprised 400 stakeholders from the organic food sector participating in various phases of the study. HACCP audits were carried out in 100 enterprises in India. At this point, I would appreciate clarification regarding the degree of food processing represented by the products manufactured by the investigated enterprises (e.g. according to the NOVA classification). The comparative studies covered 150 entities from each country.

Stage 1 involved a literature review concerning the occurrence of microbiological hazards in organic food. Research task No. 1 was completed, resulting in publication P1. The verification of hypothesis H1 is considered justified and logically related to the obtained literature review findings. The literature review showed that microbiological hazards constitute a significant food safety issue in the organic food sector, particularly in the context of the use of natural fertilisers, growing conditions and the risk of foodborne infections. The presented conclusions confirm that the identification and analysis of microbiological hazards represent an important element of the risk analysis approach.

In the second stage of the research, the functioning of food safety systems in organic food processing enterprises in India was evaluated using HACCP audits and the FMEA method. The obtained results demonstrated that all analysed enterprises had implemented food safety management systems compliant with regulatory requirements; however, the level of implementation of particular system elements varied considerably. The highest level of compliance was observed in relation to HACCP system documentation, whereas lower levels of implementation concerned operational activities such as monitoring, verification, validation of control measures, and the effectiveness of corrective actions. The application of the FMEA method enabled the identification of risk levels depending on the type of production and the size of the enterprise. The highest levels of risk were found in the rice production sector and in small enterprises processing RTE products, fruit and vegetables, and dairy products, whilst the lowest risk was recorded in enterprises in the meat sector and large production plants.

Stage 3 involved the identification of factors affecting the level of HACCP implementation in Indian organic food processing enterprises. Particular emphasis should be placed on the development of a detailed audit questionnaire serving as the basis for evaluating enterprise compliance with HACCP requirements. The developed research tool enabled a comprehensive

analysis of both the formal and operational elements of the food safety system. The appropriate combination of quantitative methods and comparative analysis deserves special mention, as it yielded results of both scientific and practical value. The use of real audit data enhances the reliability of the analyses and demonstrates the ability to apply research tools used in food safety management practice. At the same time, it should be noted that extending the analyses to include additional organizational factors, such as the degree of processing, could have provided a more comprehensive understanding of the determinants influencing the effectiveness of HACCP implementation in the organic food sector.

Hypotheses H2 and H3 were positively verified and logically linked to the conducted empirical research and statistical analyses. It was demonstrated that audits constitute an effective tool for assessing the functioning of systems based on HACCP principles, enabling the identification of both areas of compliance and areas requiring improvement. Moreover, statistical analyses confirmed that enterprise size and production type influence the level of compliance with food safety requirements, with higher risk levels observed in small enterprises within the organic sector.

The second and third stages of the research demonstrate the PhD Candidate's broad research skills and her ability to apply a variety of food safety assessment methods. Particular mention should be made of the combination of classic audit tools based on the HACCP system with the FMEA method used for quantitative risk assessment, as well as the conduct of comparative analyses taking into account the type of production and the size of enterprises. The scope of the conducted analyses confirms the Candidate's ability to integrate qualitative and quantitative methods, properly interpret results, and formulate conclusions of both scientific and practical significance for food safety management practice.

In stage 4, the PhD Candidate presented a comparative analysis of practices related to sustainable development, quality management and compliance with food safety requirements in the organic food sector in India and Italy. Particular emphasis should be placed on the comprehensive approach to the research problem, covering three interrelated areas: food safety, quality management and sustainable development. Such an approach is consistent with current global trends in food sector management, in which food safety is no longer analysed solely from the perspective of compliance with sanitary requirements, but rather as an element of a broader system of responsible and sustainable enterprise management. The Author accurately identifies the interrelationships between the effectiveness of food safety systems, the level of quality process organization, and the implementation of sustainability practices. The conducted analyses confirm that management systems in the food sector, including the organic food sector,

currently require the integration of quality-related, environmental, and social aspects. The results obtained at this stage enabled the positive verification of hypothesis H4, indicating the occurrence of differences in sustainability practices and levels of compliance with food safety requirements among stakeholders in the organic food sector.

The formulated conclusions are consistent with the scope of the conducted research and the obtained empirical findings. The author correctly points out that formal compliance with food safety system requirements does not always translate into the effectiveness of operational activities. I would appreciate the Candidate's opinion regarding the main causes of such situations. Also worthy of note is the apt emphasis on the importance of a risk-based approach and the usefulness of food safety audits and the FMEA method in assessing the effectiveness of HACCP system implementation. Particularly valuable is the comprehensive approach combining food safety, quality management, and sustainability issues. The conclusions could, however, be elaborated further in certain aspects, especially with regard to the differentiation of stakeholders and sustainability practices. Fundamental to the effective functioning of food safety management systems is the development and maintenance of a positive food safety culture. Therefore, I would appreciate the Candidate's comments on the obtained results in the context of food safety culture.

In summary of the substantive evaluation of the doctoral dissertation, I conclude that the dissertation has been prepared carefully and thoughtfully, and that the entire work constitutes a coherent and logical whole. The conducted research and formulated conclusions are of scientific significance. The comments included in this review in no way diminish the value of the dissertation and should be treated solely as a part of scientific discussion.

5. Summary and final conclusion

The submitted doctoral dissertation constitutes an original and valuable scientific study, addressing a current and significant issue related to food safety in the organic food sector from an international perspective. Particular recognition should be given to the broad scope of the research, the approach integrating food quality and safety issues with sustainability aspects, and the skilful application of diverse research methods. The substantive quality of the dissertation, the methodological correctness of the conducted research, and the practical value of the obtained results, which may contribute to improving food safety management systems in the organic food sector, should all be highly appreciated. The research carried out and the analysis of the empirical data demonstrate that the PhD Candidate has demonstrated skills in proper planning and execution of research, a comprehensive and analytical approach to the problem at

hand, consistency in drawing conclusions and verifying research hypotheses, as well as a synthetic approach. The scientific publications constituting the reviewed doctoral dissertation fit well within the current research trends in food safety management, are characterized by high methodological quality, and constitute a valuable contribution to the development of risk assessment tools. The doctoral dissertation submitted by MSc. A.P. Murali, entitled: "Assessment of ensuring food safety among stakeholders of organic food products", constitutes an original and valuable scientific study, as well as making a significant contribution to the development of the scientific discipline of food technology and nutrition.

Final conclusion

The submitted doctoral dissertation fulfils the requirements specified in Article 187, sections 1–4 of the Act of 20 July 2018 – Law on Higher Education and Science (Journal of Laws of 2024, item 1571, as amended). In view of the above, I hereby submit a request to the Disciplinary Board of Food Technology and Nutrition at the Warsaw University of Life Sciences for the dissertation to be accepted and for MSc. A.P. Murali to be admitted to the subsequent stages of the doctoral procedure.

Taking into account the high academic standard of the thesis, the topicality of the subject matter, the PhD candidate's extensive research skills, and the significant cognitive and practical value of the work, I propose that the doctoral thesis be awarded a distinction.

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