

DIGITAL HACCP AND ISO 22000 FOR LOW-COST FOOD SAFETY IMPROVEMENT IN INSTITUTIONAL FOODSERVICE: A PRE-POST PILOT STUDY

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Abstract: In public institutional foodservice, food safety depends not only on HACCP documentation, but also on rapid deviation detection, clear responsibility and reliable operational records. This is particularly relevant in school and hospital foodservice, where meals are prepared under time pressure, variable deliveries and increased consumer vulnerability. This paper evaluates a Food Safety Management System improvement model combining HACCP and ISO 22000 requirements with simple digital tools and workplace micro-training. A six-month pre-post pilot study was conducted in a school cafeteria and a hospital kitchen. The improvement package included electronic control lists, digital temperature records with alerts, KPI boards, visual standards and a RACI matrix for CCPs and OPRPs. After implementation, the reported percentage changes refer separately to the school cafeteria (S1) and the hospital kitchen (H1): nonconformities per 1,000 meals decreased by 43% and 40%, mean CAPA closure time fell by 47% and 46%, and temperature-related incidents per 1,000 meals were reduced by 55% and 57%, respectively. Monitoring timeliness and record completeness increased by 10-12 percentage points, near-miss reporting rose from 3 to 7 cases per month in S1 and from 5 to 11 in H1, and cost of quality declined by 24% and 23%, respectively. The findings indicate that low-cost HACCP digitalization can strengthen food safety culture and the PDCA cycle without complex information systems.

Keywords: HACCP; ISO 22000; Food Safety Management System; Institutional Foodservice; Food Safety Culture

1. INTRODUCTION

Institutional foodservice in public units belongs to those areas of organizational activity in which food product safety is directly linked to human safety, the reliability of technical facilities and the conditions of the working environment. School cafeterias and hospital kitchens serve particularly vulnerable populations, while their daily operation is carried out under time pressure, staff turnover, dietary diversity and the need to maintain service continuity. Under such conditions, system documentation cannot be treated as an end in itself. It should operate as a practical instrument for day-to-day risk control.



The importance of reliability in mass catering extends beyond public institutions, because in organized tourism the consistency of meal standards and service organization contributes to the assessment of the whole service. This strengthens the assumption that mass catering should be analysed as a service system in which safety, quality and process repeatability affect the recipient experience (Zawada and Szczyrba, 2025a).

Safe food is a prerequisite for public health, food security and socio-economic stability (WHO, 2026). From a systems perspective, this means that hazard prevention practices must be strengthened not only in food industry plants, but also in places where meals are prepared and served, including schools, hospitals and other mass catering units. In mass catering establishments, the legal and organizational foundation of food safety is formed primarily by GHP, GMP and the HACCP system (Szczyrba and Dziuba, 2023), the implementation of which is required by food law and operationalized through prerequisite programmes and hazard control. ISO 22000:2018 is therefore treated in this study as a voluntary management and integration framework that can strengthen communication, responsibility and the PDCA cycle, but it does not replace the mandatory GHP/GMP and HACCP basis. At the same time, the source material indicates that the effectiveness of these systems in institutional units depends on PRP/OPRP maturity, leadership quality, food safety culture, supplier relationships and data discipline in routine supervision. The research problem is therefore not limited to whether a unit has a HACCP plan, but concerns whether that plan functions as a real mechanism for detecting deviations, initiating corrective actions and supporting organizational learning.

ISO 22000:2018 strengthens the role of the process approach, communication, hazard analysis and the PDCA cycle, thereby enabling technical requirements to be linked with management and organizational responsibility (ISO, 2018; Chen et al., 2020; Rihawi, 2024). Studies concerning school and hospital foodservice still indicate gaps between staff knowledge and practice, especially in hand hygiene, temperature control and allergens (Guennouni et al., 2022; Licata et al., 2024; Salvador et al., 2024). For this reason, solutions that do not increase the documentation burden but improve record timeliness and response speed are becoming increasingly important. This perspective also corresponds to the Quality 5.0 concept, because technology is used as a support for human decision-making and learning, and to the broader idea of health safety culture, understood as strengthening risk awareness and safe organizational practices in everyday work.

The aim of this article is to assess whether a digital-organizational improvement package, consistent with the logic of HACCP and ISO 22000, can serve as a low-cost safety improvement system in institutional foodservice. The specific objective is to determine which elements of the package - micro-training, visual standards, mobile checklists, temperature registers, KPI boards and the RACI matrix - strengthen PRP/OPRP discipline, incident response speed, record completeness and cost of quality. In relation to this objective, the following research question was formulated: how does low-cost HACCP digitalization, supported by ISO 22000 requirements, affect measurable safety and quality indicators in public institutional foodservice units?

Hypothesis H1 assumes that the use of simple digital tools improves monitoring timeliness and the completeness of FSMS records. Hypothesis H2 assumes that clear assignment of responsibility for CCPs/OPRPs shortens the response time to deviations and reduces the number of nonconformities. Hypothesis H3 assumes that micro-training and visible

KPI boards strengthen food safety culture, as reflected in a higher number of near-miss reports and lower cost of quality.

2. RESEARCH BACKGROUND

HACCP remains the starting point for building an effective food safety system. In the classical view, a HACCP plan is a set of documents prepared to control significant hazards in a food business, and food chain actors should understand hazards and the measures used to control them (Codex Alimentarius Commission, 2022). In institutional foodservice, this requirement means translating procedures into actions performed at the workstation, in real time and under variable staff workload.

ISO 22000:2018 integrates FSMS requirements with HACCP principles and prerequisite programmes, while organizing the system through the process approach, communication and PDCA. Compared with ISO 22000:2005, the new version of the standard structures management and the methodology of hazard analysis more clearly, which is important for distinguishing PRPs, OPRPs and CCPs (Chen et al., 2020). From the perspective of small and medium-sized public units, however, the key issue is that standard requirements should not lead to formalism, but should support a cycle of rapid detection, escalation, decision-making and closure of corrective actions.

Supporting HACCP with the FMEA method helps structure the assessment of causes, effects and risk priorities in food industry processes; it may therefore act as a useful bridge between hazard analysis and the practical definition of preventive actions (Szczyrba and Ingaldi, 2024). In public kitchens, many deviations do not result from the incorrect design of a single CCP, but from insufficient maturity of prerequisite programmes, such as segregation, washing, disinfection, temperature control, delivery documentation and personal hygiene. This perspective is consistent with the source data, where many nonconformities in institutional foodservice were operational in nature and concerned PRP/OPRP discipline rather than CCP errors alone. Integrated occupational safety management in ready-to-eat meal and canned meat production also indicates that food safety routines should be connected with workplace safety, risk identification and process discipline, especially where manual operations, thermal treatment and hygiene regimes intersect (Szczyrba and Szataniak, 2024).

The second pillar is food safety culture. FSC can be understood as an organizational value related to leadership, engagement and cultural context, while its maturity is empirically linked with the cost of quality (Pai et al., 2024; Spagnoli et al., 2024). This means that staff behaviour, communication style and readiness to report potentially hazardous events are as important as documentation itself. Consequently, cultural measures, such as participation in micro-training and the number of near-miss reports, should be analysed alongside process indicators.

The third pillar is FSMS digitalization. Digital technologies, including IoT, RFID, big data and blockchain, can increase data accuracy, reduce waste and strengthen real-time monitoring (Charlebois et al., 2024). At the same time, the literature emphasizes implementation barriers: costs, system integration and digital competencies, including the competencies of leaders in AI-supported digital environments (Ingaldi and Ulewicz, 2025). For school and hospital kitchens, lightweight solutions may therefore be more reasonable: mobile checklists, simple temperature alerts, cloud-based registers and clear if-then rules. The evolution of quality management towards Quality 5.0 also supports the argument that digital quality systems should combine technology, data, organizational maturity and the

human role, rather than replace staff responsibility with automation alone (Czajkowska, 2026). In this sense, the proposed improvement package is not only a technical intervention, but also a socio-technical solution consistent with Quality 5.0 and with the development of a health safety culture in institutions serving vulnerable consumer groups. A more advanced direction is represented by blockchain-based food safety systems for shared kitchens, in which the roles of participants, access to information and resource traceability are emphasized (Jang et al., 2024). In the context of the present research, however, the key issue is not the implementation of advanced technology, but the appropriate matching of tools to organizational maturity. Low-cost digitalization should start where paper documentation becomes outdated, does not enforce response and does not support management reviews.

The fourth pillar is operational management. Agility in food-processing enterprises is associated with shorter decision cycles and greater responsiveness, while Lean practices and human behaviours can support occupational safety (Dziuba and Szczyrba, 2023; Sá et al., 2025). In institutional foodservice systems, these findings translate into short KPI review cycles, visual standards, workplace problem solving and RACI as a tool limiting the diffusion of responsibility. In the food industry, Lean integration supports process optimization under high variability of raw materials and operating conditions, which justifies the use of simple improvement tools also in public kitchens (Al-dalain, 2026). Value Stream Mapping enables the identification of material and information flows and points where delays occur; therefore, it may support the selection of process points that should be digitized first (Sousa et al., 2026).

Table 1 directly links the four system areas discussed above with the operational risks observed in institutional kitchens and with the low-cost tools proposed in the pilot. The table shows that the intervention was designed not as a separate IT project, but as a set of controls supporting PRP/OPRP discipline, clear CCP/OPRP ownership, near-miss learning and management review.

Table 1

Conceptual linkage between HACCP/ISO 22000 requirements and elements of low-cost digitalization

System area	Operational risk	Low-cost tool	Expected effect
PRP/OPRP	Lack of timely records and undetected deviations	Mobile checklists and temperature alerts	Improved data discipline and faster escalation
CCP/HACCP	Unclear acceptance criteria and diffusion of responsibility	RACI for CCPs/OPRPs and workstation cards	Clear process ownership and shorter CAPA closure
Food safety culture	Declared knowledge without stable practice	Micro-training and KPI boards	More near-miss reports and team learning
Management review	Lack of data for PDCA	Short weekly KPI review	Closed information loop and COQ reduction

Source: own elaboration

3. RESEARCH METHODOLOGY

The article is an implementation study based on a secondary analysis of data from a pre-post pilot conducted in the first half of 2025. The source study covered two Polish public institutional foodservice units: a school cafeteria (S1) and a hospital kitchen (H1). Baseline data were collected in months 1-2, whereas months 3-6 covered the period after

implementation of the improvement package. This design made it possible to compare selected indicators before and after the intervention without introducing additional experimental variables.

The intervention covered micro-training, visual standards at the workplace, mobile checklists, digital temperature logs with alerts, KPI boards and a RACI responsibility matrix for CCP/OPRP owners. The data came from FSMS records, digital logs, SLA/OTIF purchasing and delivery documentation, and short staff surveys concerning participation in micro-training and near-miss reporting. The indicator set included process compliance, response speed, delivery stability, signals of food safety culture and cost of quality.

The adopted approach corresponds to the recommendation to combine different measures in foodservice food safety research, including cognitive and behavioural measures (Bulochova et al., 2024). In the present study, triangulation has a practical dimension: staff declarations were compared with operational records, temperature alerts and delivery indicators. This reduces the risk that the system assessment is based only on self-assessment or on the formal completeness of documents.

The assessment of results was carried out in four steps. First, the intervention package was described and assigned to HACCP/ISO 22000 requirements. Second, pre-post indicators were compiled for S1 and H1. Third, the mechanisms of change were interpreted in the light of literature on FSC, digitalization and agile management. Fourth, limitations and practical implications for public units were indicated. Statistical testing was not applied, as the source material is a purposive two-site pilot without a control group.

4. RESULTS

As shown in Table 2, implementation of the digital-organizational package improved most of the analysed indicators. The most direct effect concerned nonconformities per 1,000 meals: in S1, their number decreased from 2.8 to 1.6, which represents a 43% reduction, while in H1 it fell from 3.5 to 2.1, or 40%. In practical terms, the table indicates that significant improvement in operational process stability can be achieved even without an extensive information system, provided that digital records are linked with responsibility and KPI review.

In the area of response to deviations, Table 2 shows that the mean CAPA closure time was shortened by about 47% in S1 and 46% in H1, while temperature incidents per 1,000 meals decreased from 1.1 to 0.5 in S1 and from 1.4 to 0.6 in H1, which corresponds to reductions of 55% and 57%, respectively. At the same time, the timeliness of CCP/OPRP monitoring increased by 10 percentage points in S1 and 12 percentage points in H1, while record completeness improved by 10-12 percentage points. These data confirm that the main value of simple digital tools is not digitization of records alone, but the shortening of the time between event, information and corrective action.

Indicators related to food safety culture and staff behaviour point to increased team activity. Participation in micro-training exceeded 90% weekly in both units, while near-miss reports increased from 3 to 7 in S1 and from 5 to 11 in H1. This increase should not be interpreted as a deterioration in safety, but as greater system sensitivity to weak signals. Only the visibility of near misses enables learning before an actual incident occurs.

Table 2

Selected KPIs before and after the intervention

KPI	S1 - baseline	S1 - after intervention / change	H1 - baseline	H1 - after intervention / change
Nonconformities per 1,000 meals	2.8	1.6 / -43%	3.5	2.1 / -40%
Reduction in mean CAPA closure time	no absolute value in the source material	-47%	no absolute value in the source material	-46%
Timeliness of CCP/OPRP monitoring	88%	98% / +10 pp	84%	96% / +12 pp
Record completeness	no absolute value in the source material	+10 pp	no absolute value in the source material	+12 pp
Temperature incidents per 1,000 meals	1.1	0.5 / -55%	1.4	0.6 / -57%
Samples/batches meeting quality criteria	92%	97% / +5 pp	90%	96% / +6 pp
Deliveries within SLA/OTIF	93%	97% / +4 pp	91%	95% / +4 pp
Participation in micro-training (% of staff/week)	62%	95% / +33 pp	58%	92% / +34 pp
Near-miss reports / month	3	7 / +4	5	11 / +6
Cost of quality (COQ)	not reported	-24%	not reported	-23%

Source: own elaboration based on source data (Zawada and Szczyrba, 2025b).

Improvement also covered the supplier interface. The OTIF indicator increased from 93% to 97% in S1 and from 91% to 95% in H1, while the share of samples or batches meeting quality criteria rose from 92% to 97% and from 90% to 96%, respectively. This is important because HACCP in an institutional kitchen does not end at the heat-treatment workstation; it also covers input quality, delivery temperature, raw material compliance and supply timeliness.

The cost effect was clearly favourable: COQ decreased by 24% in S1 and 23% in H1. This result can be interpreted in the light of the relationship between food safety culture maturity and the structure of quality costs (Spagnoli et al., 2024). In practice, the cost reduction did not result from lowering requirements, but from earlier deviation detection, fewer corrective actions after the fact and more predictable operational supervision.

5. DISCUSSION

The obtained results indicate that digital HACCP does not have to mean purchasing an extensive enterprise-class system. The studied units used simple tools: checklists, temperature logs, alerts, KPI boards and RACI. Their effectiveness resulted from consistent use and integration into a rhythm of short reviews. This distinguishes digitalization understood as replacing paper with a screen from digitalization understood as shortening the PDCA loop.

The literature on digital traceability indicates that technology can shorten response time, support the identification of contamination sources and reduce the risk of foodborne

diseases (Charlebois et al., 2024). The pilot results confirm this logic at the micro-organizational level: simple reminder and alert rules were sufficient to reduce temperature incidents and improve record completeness. In this sense, low-cost digitalization is more an organizational solution than a purely technological one.

The second mechanism was responsibility. The RACI matrix for CCPs/OPRPs reduced the diffusion of task ownership, while weekly reviews with process owners stabilized escalation and CAPA closure. This is consistent with the logic of ISO 22000:2018, in which communication, responsibility and management reviews are conditions for maintaining an effective FSMS (ISO, 2018; Chen et al., 2020). In practice, each process card and checklist should answer the following questions: who monitors, who makes decisions, who approves deviations and within what time CAPA is initiated.

The third mechanism was behavioural change. The increase in micro-training participation and near-miss reporting indicates that staff more often identified and communicated weak signals. Food safety culture requires active leadership and organizational commitment, not procedures alone (Pai et al., 2024; Castro et al., 2024). In the analysed units, micro-training served as a bridge between documentation and workstation practice: it transferred lessons from incidents and observations into daily staff behaviour.

The fourth mechanism was visual standardization. Lean practices, including 5S and standard work, can influence safety-related behaviours (Sá et al., 2025). In an institutional kitchen, a visual standard is not an aesthetic addition, but a tool for reducing process variability: it reminds staff of the sequence of actions, acceptance criteria and the method of response when a deviation occurs.

From the perspective of managing a public foodservice unit, reducing documentation overload is essential. The source material indicates that implementation of selected ISO 22000 elements - communication of objectives, management reviews and incident management - strengthened PDCA without increasing the documentation burden. This is important because public institutions often operate with limited human and financial resources, and excessive formalization may lead to apparent compliance rather than real safety.

Limitations should also be emphasized. The source study covered one school cafeteria and one hospital kitchen, was purposive in nature, had no control group and was susceptible to the Hawthorne effect and parallel organizational initiatives. For this reason, the findings should not be statistically generalized. Their value lies in indicating a practical intervention model that may be replicated and tested in subsequent units.

Future research should also extend the analysis to observational audits of staff behaviour, because record completeness alone does not always mean that practice is consistent with procedure. The need to combine observation with cognitive and behavioural measures is emphasized in foodservice food safety research (Bulochova et al., 2024).

6. PRACTICAL IMPLICATIONS

Based on the synthesis conducted, an implementation sequence can be proposed for public institutional foodservice units. The first step should be to identify CCP/OPRP owners in the RACI matrix and link them to specific process cards. The second step is to implement the simplest digital registers: hygiene checklists, temperature records and alerts. The third step consists of short micro-training sessions derived from actual deviations. The fourth step is a weekly KPI review at a board visible to the team. Table 3 translates this sequence into a minimal indicator set, showing which data sources and

review frequencies are sufficient at the initial stage of low-cost digital HACCP. Such a sequence corresponds to the constraints of public institutions and does not require full FSMS computerization at the initial stage.

Table 3

Minimal indicator set for a low-cost digital HACCP system

Category	Indicator	Data source	Review frequency
Process	Nonconformities per 1,000 meals	FSMS records / checklists	weekly
Process	Timeliness of CCP/OPRP monitoring	Mobile logs	daily / weekly
Response	CAPA closure time	CAPA register	weekly
Temperature	Temperature incidents	Temperature log with alerts	daily
Suppliers	OTIF and batch quality compliance	Delivery documentation / SLA	monthly
Culture	Participation in micro-training and near-miss	Short surveys / incident register	weekly / monthly
Quality economics	COQ	Cost of quality register	monthly / quarterly

Source: own elaboration

As indicated in Table 3, the minimal indicator set should be short, clear and linked with action. If an indicator does not trigger a decision, it should not burden the team. In practice, it is sufficient to monitor process discipline, response speed, temperature stability, deliveries, food safety culture and quality costs. System extension with advanced modules, such as IoT or blockchain, should be treated as a later stage, after the basic PDCA loop has been stabilized.

7. CONCLUSIONS

The analysis confirms that digital HACCP, built on the mandatory GHP/GMP and HACCP foundation and supported by voluntary ISO 22000:2018 requirements, can serve as a low-cost system for improving safety in institutional foodservice. The condition for success is not the mere availability of applications, but their linkage with PRP/OPRP programmes, process-owner responsibility, short KPI reviews and micro-training. In this approach, digitalization becomes a tool of organizational learning, not only a change in the medium of documentation.

After implementation of the package, the changes were consistent in both pilot units: nonconformities decreased by 43% in the school cafeteria and 40% in the hospital kitchen, mean CAPA closure time was shortened by about 47% and 46%, and temperature incidents per 1,000 meals were reduced by 55% and 57%, respectively. Monitoring timeliness and record completeness improved by 10-12 percentage points, near-miss reporting increased from 3 to 7 cases per month in S1 and from 5 to 11 in H1, and cost of quality fell by 24% and 23%, respectively. The convergence of results in two different types of units suggests that the model may be useful both in a simpler organizational environment and in a kitchen with greater dietary and operational complexity.

The most important practical conclusion is that change should begin with responsibility and data discipline. The RACI matrix, mobile checklists, temperature registers with alerts and KPI boards form a simple but effective control arrangement. Micro-training closes this arrangement because it transfers lessons from deviations and near misses to everyday staff practice.

The article contributes to the area of System Safety by showing that food safety in institutional foodservice results from the interaction of people, the technical infrastructure for recording and alerting, HACCP/ISO 22000 procedures and the organizational environment. The limitations are the pilot nature of the data, the absence of a control group and the short observation horizon. Therefore, future studies should include a larger number of units, a comparison of facilities with and without implementation, and a fuller assessment of the relationship between implementation costs, COQ and safety effectiveness.

REFERENCES

- Al-dalain, R., 2026. *Exploring Lean Manufacturing Integration and Performance Evaluation for Process Optimization in the Food Processing Industry*. Production Engineering Archives, 32(1), 87-95. DOI: 10.30657/pea.2026.32.7
- Bulochova, V., Evans, E. W., Haven-Tang, C., Redmond, E. C., 2024. *Methods and measures in food service food safety research: A review of the published literature*. Heliyon, 10(4), e25798. DOI: 10.1016/j.heliyon.2024.e25798
- Castro, M., Soares, K., Ribeiro, C., Esteves, A., 2024. Evaluation of the effects of food safety training on the microbiological load present in equipment, surfaces, utensils and food manipulators' hands in restaurants. Microorganisms, 12(4), 825. DOI: 10.3390/microorganisms12040825
- Charlebois, S., Ahmad, J., Abdulrahman, A., White, C., 2024. *Digital traceability in agri-food supply chains: A comparative analysis of OECD member countries*. Foods, 13(7), 1075. DOI: 10.3390/foods13071075
- Chen, H., Liu, S., Chen, Y., Chen, C., Yang, H., Chen, Y., 2020. *Food safety management systems based on ISO 22000:2018 methodology of hazard analysis compared to ISO 22000:2005*. Accreditation and Quality Assurance, 25(1), 23-37. DOI: 10.1007/s00769-019-01409-4
- Codex Alimentarius Commission, 2022. General Principles of Food Hygiene CXC 1-1969. FAO/WHO, Rome.
- Czajkowska, A., 2026. *The Evolution of Quality Management Towards Quality 5.0: A Maturity Model Perspective*. Production Engineering Archives, 32(2), 220-229. DOI: 10.30657/pea.2026.32.18
- Dziuba, S., Szczyrba, A., 2023. *Agile management in Polish organic food processing enterprises*. Production Engineering Archives, 29(1), 101-107. DOI: 10.30657/pea.2023.29.12
- Guenouni, M., Admou, B., Bourhouat, A., El Khoudri, N., Zkhiri, W., Talha, I., Hazime, R., Hilali, A., 2022. *Knowledge and practices of food safety among health care professionals and handlers working in the kitchen of a Moroccan university hospital*. Journal of Food Protection, 85(4), 676-685. DOI: 10.4315/JFP-21-305
- Ingaldi, M., Ulewicz, R., 2025. *The role of AI in digital leadership: New competencies of leaders*. Polish Journal of Management Studies, 31(2), 106-122. DOI: 10.17512/pjms.2025.31.2.07
- ISO, 2018. ISO 22000:2018 Food safety management systems - Requirements for any organization in the food chain. International Organization for Standardization, Geneva.
- Jang, H., Lee, D., Yoon, B., 2024. Development of a blockchain-based food safety system for shared kitchens. Systems, 12(11), 509. DOI: 10.3390/systems12110509
- Licata, F., Della Polla, G., Costantino, N., Pelullo, C. P., Bianco, A., 2024. Evaluating levels of knowledge and food safety practices among food handlers in the Southern part of Italy. Heliyon, 10(10), e30722. DOI: 10.1016/j.heliyon.2024.e30722
- Pai, A. S., Jaiswal, A. K., Al Humaid, A., Jaiswal, S., 2024. A comprehensive review of food safety culture in the food industry: Leadership, organizational commitment, and multicultural dynamics. Foods, 13(24), 4078. DOI: 10.3390/foods13244078

- Rihawi, B., 2024. The impact of ISO 22000:2018 on food facilities performance with multiple production lines. *Food Additives & Contaminants: Part A*. Advance online publication. DOI: 10.1080/19476337.2024.2431281
- Sá, J. C., Oliveira, A., Hines, P., Mourão, F., McDermott, O., Marques, P. A., Zouari, A., Pathania, A., Ulewicz, R., 2025. The effects of Lean and people's behaviours on occupational safety. *Production Engineering Archives*, 31(1), 1-14. DOI: 10.30657/pea.2025.31.1
- Salvador, R. Q., Borromeo, C. M. T., Alnas, G. C., Adviento, S. V. M. G., Asuncion, A. C., Limon, M. R., et al., 2024. Safe plates in the school space: Investigating compliance of food safety standards among school-based food service providers. *Food and Humanity*, 2, 100283. DOI: 10.1016/j.foohum.2024.100283
- Sousa, R. M., Dinis-Carvalho, J., Hines, P., 2026. Value Stream Mapping: some Pragmatic Aspects. *Production Engineering Archives*, 32(1), 112-122. DOI: 10.30657/pea.2026.32.10
- Spagnoli, P., Defalchidu, L., Vlerick, P., Jacxsens, L., 2024. The relationship between food safety culture maturity and cost of quality: An empirical pilot study in the food industry. *Foods*, 13(4), 571. DOI: 10.3390/foods13040571
- Szczyrba, A., Dziuba, S., 2023. Good Manufacturing Practices for Quality and Safety Management in the Food Industry. *Materials Research Proceedings*. DOI: 10.21741/9781644902691-34
- Szczyrba, A., Ingaldi, M., 2024. Implementation of the FMEA Method as a Support for the HACCP System in the Polish Food Industry. *Management Systems in Production Engineering*, 32(3), 357-371. DOI: 10.2478/mspe-2024-0034
- Szczyrba, A., Szataniak, E., 2024. Integrated Approach to Occupational Safety in the Production of Ready-to-Eat Meals and Canned Meat: Challenges and Solutions. *System Safety: Human - Technical Facility - Environment*, 6(1), 175-183. DOI: 10.2478/czoto-2024-0019
- WHO, 2026. Food safety. World Health Organization. Available online: <https://www.who.int/news-room/fact-sheets/detail/food-safety> (accessed 16 June 2026).
- Zawada, M., Szczyrba, A., 2025a. Mass Catering Service Quality as a Determinant of Customer Satisfaction in the Tourism Sector. *System Safety: Human - Technical Facility - Environment*, 7(1), 99-107. DOI: 10.2478/czoto-2025-0010
- Zawada, M., Szczyrba, A., 2025b. Quality systems in institutional foodservice: Review and improvement pathways (HACCP, ISO 22000, GHP/GMP). *System Safety: Human - Technical Facility - Environment*, 7(1), 551-559. DOI: 10.2478/czoto-2025-0050