Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 25, Issue 3, 2025
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DECONSTRUCTING HACCP PERFORMANCE: A NINE-DIMENSIONAL ASSESSMENT FRAMEWORK FOR ROMANIAN FOOD SERVICE OPERATIONS

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Abstract

In this paper we used a dimensional scoring methodology on a 127-item questionnaire (with nine critical dimensions) to assess the HACCP system's implementation in 392 public food establishments in Romania. The findings show serious flaws in the infrastructure for food safety: 95.4% of the units had insufficient provisions for supplementary facilities, and 87.5% of the units received quality control scores lower than 5/10. Sixty-one percent of the staff has inadequate training, and there are serious issues with service coordination and technological flow management. However, protective equipment is better managed (77.6% moderate scores). Statistical analyses indicate significant associations between FIFO application and labelling ($\chi^2 = 12.6$; $p = 0.013$), as well as between supplier certification and documentation control ($\chi^2 = 17.5$; $p = 0.002$). Geographical differences and educational level influence overall performance. The study highlights the discrepancies between the requirements specified in legislation and the need to implement systemic interventions focused on traceability and continuous monitoring.

Key words**:** *HACCP performance metrics, food safety infrastructure assessment, operational compliance framework; dimensional scoring methodology in food safety analysis*

INTRODUCTION

Food safety in the public catering sector is a continuous concern for health authorities and economic operators, especially in the context of the exponential growth of consumption outside individual households and the diversification of business models in the HoReCa field. The implementation of the HACCP system, although mandatory under Regulation (EC) No. 852/2004 on the hygiene of foodstuffs [10], remains an operational challenge for public catering establishments in Romania, where financial, organisational, and professional competence barriers create discrepancies between the regulatory framework and daily practice [3].
We observe a decrease in interest in HACCP research in international scientific literature over the last decade. Predominantly, the regions where the HACCP system has received sustained academic attention recently are African and Middle Eastern countries (e.g., [1], [6], [7]).

Based on a bibliometric analysis spanning 4 decades, the study by Radu et al. [8] notes that there was limited scientific activity in the field until the early 1990s, and only then, as concerns about food safety grew, did the first significant efforts emerge. Until 2012, the United States conducted the most research on topics related to the HACCP system, when Italy, the United Kingdom, China, and Greece took numerous initiatives in this regard. The authors also highlighted the barriers to the wide spread implementation of the HACCP system (in terms of costs, complexity, lack of training and resources in enterprises), as well as its obvious opportunities (increasing consumer demand, strict rregulations etc.), offering future research directions focused on sustainability, regenerative requirements, adaptability to emerging risks, and regulatory compliance [8].
One of the few articles in recent literature on the HACCP system in Romania is the research conducted by Borda et al. [2], which analyses the level of knowledge of Romanian consumers about food risks, their attitude

towards certified products, and reliable sources of information. The study results show that approximately half of the respondents were unable to identify relevant biological hazards (mycotoxins, Listeria, Campylobacter, Yersinia, Clostridium), although they perceived substances like food additives or genetically modified organisms – which, in reality, do not pose direct risks if regulated – as dangerous. The authors' research also shows that, worryingly, certified products tend to generate trust, but consumers do not distinguish between different certification schemes. At the same time, although consumers consider scientific sources (books and specialised texts) credible, they prefer to seek information from their immediate environment (family, friends) and the mass media, and only a small percentage of scientific information influences their decisions.

Given the limited number of studies currently available on the compliance of public food establishments with HACCP principles [4][5][9] and the priority of this topic for public health, we believe it is necessary to continuously map how commercial entities in the HoReCa sector meet HACCP standards. In this regard, the present research aims to map the actual level of HACCP principle implementation in Romanian restaurants and identify the socio-demographic and organisational factors that influence the quality of this system's implementation.

MATERIALS AND METHODS

The present research was conducted based on a 127-item questionnaire covering all HACCP areas to analyse compliance with hygiene and sanitation standards in restaurants and other dining establishments. The theoretical basis came from European legislation 852/2004 regarding food hygiene, supplemented by the regulations of the veterinary sanitary authorities in Romania. Data collection was conducted using digital forms distributed through Survey Monkey and promoted on Linked Into restaurant professionals. 392 people from most regions of the country participated. Statistical processing was done in SPSS version 20, at a 95% confidence interval. The questionnaire items were distributed across nine themes that covered the entire operational chain: quality management, work wear, raw material supply, product storage, cooking processes, dining room layout, service team organisation, auxiliary equipment, and activity monitoring. The purpose of the questions was to verify two essential aspects: whether there are written protocols and the extent to which they are put into practice daily, the gap between theory and application being a recurring issue in the field of consumer protection.

The data was transformed numerically and aggregated across the 9 domains investigated. Frequency distributions were calculated for broad characterisation in order to create composite indicators for each assessed area. Association analysis and comparison tests were used to identify correlations between variables.

RESULTS AND DISCUSSIONS

Staff Organisation and Training

The percentage of responses classified between 1 and 4 reaches 61.0%, indicating a significant presence of unclear or incorrectly applied procedures. The average range (5–7) accounts for 38.8%, and higher scores are very rare, only 0.3% (Figure 1). In Bucharest, the percentage of low evaluations reaches 13.0%, while 7.1% fall into the average range. In Cluj-Napoca, the percentages are 7.4% for both categories. Those with vocational training have a significantly greater percentage of scores between 1 and 4, at 30.1%, whilst those with university degrees have the lowest percentage (4.8%). The absence of skills matrices, job descriptions, and consistent professional training programs is reflected in these distributions. Without these tools, the unit cannot clearly demonstrate employee competence. Insufficient documentation of training makes it difficult to identify those responsible in case of an incident, and staff turnover hinders the effective transfer of experience within the team. In the absence of a structured training system, clearly assigning

responsibilities in the event of incidents becomes difficult, and excessive reliance on informal training methods compromises the effectiveness of any subsequent HACCP strategy implemented.

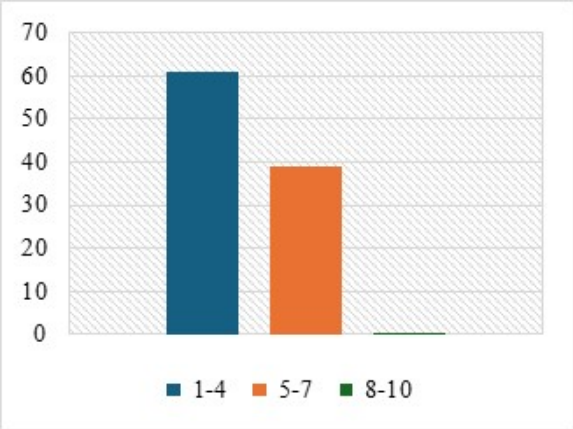

Fig. 1. Distribution of scores on the staff organisation and training dimension.
Source: Own item analysis performed in SPSS.

Responsibility and Quality Control

87.5% of the evaluations are below the threshold of 5, and the remaining 12.5% (instead of 11.5) fall within the 5-7 range – with no scores above that (Figure 2). Essentially, self-control procedures are either absent or merely declarative. Without effective checks for potential deviations and without records of corrective measures taken, the preventive function of the HACCP system disappears, and quality control becomes an occasional endeavour, triggered only when a problem arises.

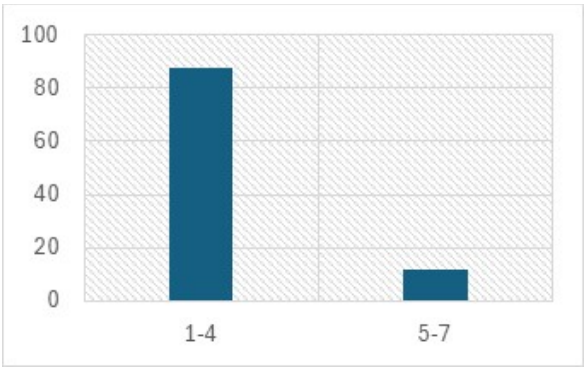

Fig.2. Distribution of scores on the responsibility and quality control dimension
Source: own item analysis conducted in SPSS.

Without clarification of responsibilities for each critical point, accountability in the event of a microbiological incident becomes difficult, and delays in remediation increase the risk of product recalls and sanctions.

Protective Equipment and Uniforms

Regarding the provision of specific equipment and work clothing to personnel, empirical data show that the majority of units (77.6%) received a minimum score (2 out of 5), indicating that the protection provided is insufficient. Only 20 (5.1%) reached level 3, and 68 (17.3%, Figure 3) fall below the adequate threshold (below 5 points). The use of minimal protective equipment, such as masks, caps, and non-slip footwear, is consistent, but other protective gear, like cut-resistant gloves, is almost non-existent. Thus, although there is a minimum form of individual protection, the real commitment to worker safety is reduced, with lower costs being prioritised over adequate and up-to-date protection.

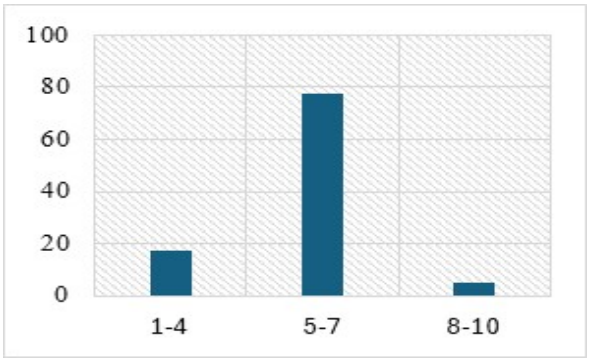

Fig. 3. Distribution of evaluations regarding protective equipment and uniforms.
Source: Own item analysis performed in SPSS.

Purchasing and Receiving Raw Materials

First-In, First-Out (FIFO) practices are applied in 63.3% of cases, reflecting scores between 5 and 7 (Figure 4). Labelling is relatively common: the date of receipt appears in 80.1% of cases, and the expiration date is mentioned in 70.4% of cases.

The temperatures of refrigeration equipment are monitored daily in 51.3% of restaurants, while 6.6% do not perform any checks at all. The storage regime between 0 and 4°C is maintained in 87.8% of establishments, a favourable result in terms of microbiological control.

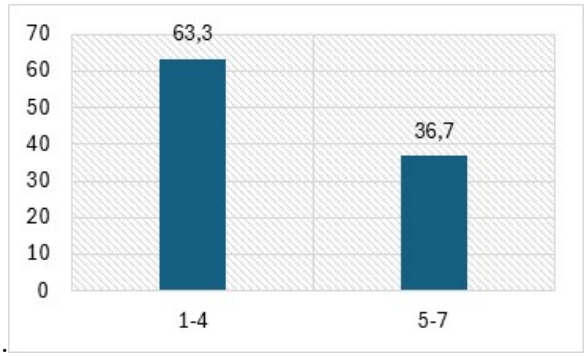

Fig..4. Distribution of assessments regarding raw material procurement and reception
Source: Own item analysis conducted in SPSS.

Freezing spaces are lacking in 16.3% of units, and 29.8% have large rooms (> 10 m²), which, if not managed efficiently, can lead to unnecessary energy consumption. Statistical analysis reveals a significant link between using the FIFO system and proper labelling ($\chi^2 \approx 12.6$; $p = 0.013$), highlighting that operators who correctly mark products also manage stock rotation adequately.

Regarding procurement, 35.5% of respondents select suppliers based on formal contracts, 26.3% rely on informal recommendations, and 16.6% admit to occasional purchases without supporting documentation. Regarding certifications, only 23.7% verify the documentation with each delivery, while 10.0% never consult these records. The reception of products by specialised personnel – a sign of a mature logistics system – occurs in 41.6% of cases, with the remaining units using informal methods: chefs take delivery of the goods without formal procedures, or the supplier leaves them unattended.

Storage and Food Safety

Most units (84.7%) fall within the average evaluation range (5–7), only 9.4% achieve high scores (8–10), and 5.9% are below the minimum acceptable level (below 5). Although separating raw foods from those intended for consumption and adhering to the FIFO principle are common practices, the documentation of corrective actions remains superficial, usually limited to informal mentions. The weighted average is around 6.1, but maximum values are rare, indicating the need for much more documented real-time monitoring.

Preparation and Technological Flow

Over 61% of the units score very poorly (1-4), while the remaining 38.8% are between 5 and 7, with no unit reaching the highest level. The differences between cities are small: Cluj-Napoca has 7.4% in the medium range, while Craiova has only 3.1%. 35% of those without higher education are in the low-income zone, compared to 6.1% among those with university degrees. Restaurants with 50-100 seats show a peak of 12.4% average scores. The context reveals problematic work areas, violations of the cold-hot path, and unsafe measuring equipment, providing logical explanations for the absence of maximum evaluations. These shortcomings increase the risk of contamination, and a positive correlation ($r = 0.102$) between the technological flow and auxiliary facilities shows us that investments in related spaces indirectly influence the quality of the operation.

Service Areas and Facilities

Almost half of the restaurants (43.9%) score low (1-4), compared to 55.9% that are in the average range (5-7). Lighting is considered adequate by 46.2%, but 27.8% report dark areas, and 15.8% identify it too intense. Separate sanitary facilities for men and women, as well as for people with disabilities, are present in 55.6%, and full ventilation is only functioning in 36.2% of cases. Disinfection of cutlery before serving occurs in 57.1%; however, 14.5% of it is simply placed on the table without cleaning. Waste management is problematic: only 54.1% empty the bins regularly, and only 42.6% practise recycling. Overall, the service areas are poorly rated, with significant deficiencies in ventilation, spacing, and universal accessibility.

Service and Coordination

Only 31.1% of units offer regular training to their team in serving techniques; another 41.1% hold occasional sessions, and 5.6% do not train at all. Dedicated management is present in half of the restaurants; in 17.6%, waiters act autonomously, leading to inconsistency. Shift scheduling is rigid for 37.2%, and 22.7% of employees work over time. Regarding hygiene, only 21.9% used is posable gloves; the rest handle the cutlery unsterilised. Overall, the service performs

below average: less than a third apply standard preparation procedures, and many rely solely on experience.

Complementary Facilities and Comfort

This dimension is the most deficient: 95.4% score very low (1-4) and only 4.6% average (5-7), with no high evaluations. Average values occasionally appear in restaurants with 50-100 seats (5.1%) and more frequently among women (4.6%). The complete absence of top scores (8-10) highlights the neglect of investments in comfort – even though these would positively influence visitor satisfaction and the duration of visits.

CONCLUSIONS

The HACCP system's implementation in Romanian public dining establishments shows a notable inconsistency between existing practices and regulatory mandates. The evaluation of the nine facets of food safety identifies significant shortcomings that affect eateries' ability to offer patrons standards that are acceptable.

The results obtained on the quality control dimension show the absence of functional monitoring and verification mechanisms in most of the evaluated units. Self-control procedures are either nonexistent or remain on a declarative level without being translated into measurable daily practices. Thus, the preventive nature of the HACCP system is lost, transforming it into a reactive tool that intervenes after an event.

The absence of skill matrices, clear job descriptions, and systematic training programs creates ambiguity in the allocation of responsibilities and makes it difficult to trace decisions in the event of an incident. The positive correlation between educational levels and the quality of implementation reflects the fact that specialised training is a determining factor in the effective adoption of HACCP principles.

The technological flow and preparation processes demonstrate serious vulnerabilities, with frequent violations of work area separation and compromise of the cold chain. The statistical association between the quality of the technological flow and the provision of auxiliary facilities indicates the nature of the identified problems, highlighting the need for integrated interventions.

The support infrastructure, assessed in terms of complementary facilities, shows the lowest level of compliance among all the dimensions analysed. A lack of investment in ventilation systems, adequate sanitation facilities, and waste management creates favourable conditions for cross-contamination, which compromises the sustainability of any control measures implemented at the operational level. Furthermore, the procurement and receiving practices are entirely unique, with a relatively consistent application of the FIFO principle, contrasting with the sporadic verification of supplier documentation. The statistically significant association between FIFO applications and labelling practices indicates the existence of excellent practices that work when implemented simultaneously.

The uniform geographical distribution of the identified deficiencies indicates that these problems are prevalent across a significant portion of our country. The food sector as a whole, not just certain regions, faces barriers to the implementation of HACCP.

The results confirm the persistence of organisational, financial, and competency barriers identified in specialised literature, but their intensity in the Romanian context seems amplified by specific contextual factors. Transposing the European legislative framework without developing implementation capacities creates a false compliance that does not lead to effective practices for ensuring food safety.

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