# Assessment Of Sanitary and Epidemiological Safety in Railway Catering Facilities: An Extended Analysis from The Kokand Region (Uzbekistan)

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## Abstract

Ensuring sanitary and epidemiological safety in public catering is a key priority of modern public health systems. Railway catering facilities require special attention due to high workloads, strict schedules, centralized food distribution, and continuous human interaction, where even minor hygiene violations can lead to serious foodborne outbreaks.

This study assessed sanitary conditions in 10 railway catering facilities of “Uzbekistan Railways” in the Kokand region (2024–2025) using a mixed-method approach, including laboratory analyses, inspections, administrative data, and staff surveys. A total of 31 inspections with laboratory testing were conducted. Analyses covered nitrate levels in vegetables, iodine in salt, meal caloric value, and water quality, alongside bacteriological testing of food, water, and surfaces. Results showed a 73.7% reduction in administrative violations compared to the previous year. However, risks remained: 27.6% of vegetables exceeded nitrate limits, while contamination was found in 12.9% of water samples and 9.9% of surface swabs. Despite high staff hygiene knowledge (88.3%), contamination persisted, indicating that knowledge alone is insufficient without systemic improvements. These findings highlight the need for integrated food safety management, including strict surveillance, continuous training, infrastructure upgrades, and stronger supplier control.

***Keywords:*** *food hygiene, sanitary surveillance, railway catering, food safety, microbiological contamination, nitrates, occupational health, Uzbekistan*

## INTRODUCTION

Food safety is one of the most important components of preventive medicine and environmental health. In modern industrial societies, public catering facilities play a significant role in maintaining population health by ensuring access to safe and

nutritionally adequate food. However, these facilities may also become sources of epidemiological danger if sanitary and hygienic standards are not strictly followed.

Railway catering systems are especially important because they operate within industrial transport networks involving large groups of workers who rely on centralized food preparation systems. The quality and safety of meals directly influence occupational productivity, worker well-being, and overall public health conditions.

Globally, foodborne diseases continue to represent a major health burden. According to the World Health Organization (WHO), unsafe food causes millions of illnesses annually. Chemical contamination, microbial growth, and improper food handling remain the leading causes of food-related morbidity. Developing countries face particularly serious challenges due to limited infrastructure, insufficient monitoring systems, and inadequate implementation of food safety standards.

In Uzbekistan, sanitary and epidemiological safety is regulated through national sanitary legislation, including SanPiN 0211-06. These regulations establish standards for food production, transportation, storage, preparation, and distribution. Regional sanitary-epidemiological services are responsible for enforcing these standards through inspections and laboratory analyses.

Despite improvements in the sanitary control system, several challenges remain unresolved. These include:

insufficient technical modernization,

inconsistent compliance with hygiene standards,

inadequate quality control of agricultural products,

contamination of water supply systems,

and limited implementation of modern food safety management systems such as HACCP.

The Kokand region is an important industrial and transport center in the Fergana Valley. Railway catering facilities operating in this region serve a significant workforce and therefore represent an important area for sanitary surveillance research.

The aim of this study was to evaluate the sanitary and epidemiological safety of railway catering facilities in the Kokand region by analyzing laboratory findings, inspection outcomes, and employee hygiene awareness.

## MATERIALS AND METHODS

### 2.1 Study Design

The study utilized a comparative observational design covering the period from January 2024 to December 2025. Both retrospective and prospective approaches were applied.

The research integrated:

laboratory analyses,

sanitary inspection data,

administrative enforcement records,

and employee surveys.

This mixed-method design allowed comprehensive evaluation of both environmental and human factors influencing food safety.

### 2.2 Study Area

The study was conducted in the Kokand region of Uzbekistan. Kokand is one of the largest transport and industrial centers of the Fergana Valley and contains multiple railway infrastructure facilities.

The investigated catering facilities operated under “Uzbekistan Railways” Joint Stock Company and primarily served railway employees.

### 2.3 Study Objects

A total of 10 railway catering facilities were included in the study.

The facilities were categorized according to sanitary risk levels:

High-risk facilities – 2

Medium-risk facilities – 6

Low-risk facilities – 2

The distribution remained stable during the study period.

### 2.4 Inspection Procedures

During 2025, 31 scheduled sanitary inspections were conducted.

Each inspection included:

visual examination of sanitary conditions,

evaluation of food storage conditions,

assessment of employee hygiene,

analysis of kitchen sanitation,

verification of medical records,

laboratory sample collection.

All inspections were accompanied by laboratory analyses, ensuring complete diagnostic coverage.

2.5 Laboratory Methods

Chemical Analysis

Chemical testing included:

nitrate concentration in vegetables,

iodine content in salt,

caloric value of prepared meals,

quality indicators of drinking water,

assessment of frying oil safety.

Standard laboratory methods approved by national sanitary regulations were applied.

Bacteriological Analysis

Microbiological evaluation included:

food contamination testing,

drinking water microbiology,

environmental swabs from surfaces and equipment.

The analyses were performed using standard microbiological culture techniques.

2.6 Staff Survey

A structured questionnaire was administered to 35 employees.

The questionnaire evaluated knowledge regarding:

personal hygiene,

handwashing procedures,

cross-contamination prevention,

safe temperature control,

food storage conditions,

importance of iodized salt,

sanitary norms and regulations.

Participation was voluntary and anonymous.

2.7 Statistical Analysis

Descriptive statistical methods were used.

The following indicators were calculated:

percentages,

compliance rates,

contamination frequencies,

year-to-year comparative changes.

The results were compared with national sanitary standards and WHO recommendations.

3. RESULTS

3.1 Facility Risk Classification

The classification of facilities according to sanitary risk remained unchanged between 2024 and 2025.

| Year | High Risk | Medium Risk | Low Risk | Total |
|---|---|---|---|---|
| **2024** | 2 | 6 | 2 | 10 |
| **2025** | 2 | 6 | 2 | 10 |

The stability of the classification suggests that no major structural changes occurred during the study period.

3.2 Chemical Analysis Results

Drinking Water Quality

A total of 32 drinking water samples were analyzed.

Among them:

30 samples met sanitary standards,

2 samples failed to comply.

The compliance rate was 93.8%.

Although the majority of samples were acceptable, the existence of contaminated samples indicates potential deficiencies in water supply infrastructure and disinfection systems.

Dairy Products

Ten dairy product samples were analyzed.

All samples met sanitary requirements, indicating proper storage and handling conditions.

Frying Oil Quality

Fifteen samples of cooking oil were examined.

No violations were detected.

This finding indicates satisfactory thermal processing conditions and appropriate oil replacement practices.

Iodized Salt

Twenty-seven salt samples were analyzed.

Two samples showed insufficient iodine concentration.

The compliance rate was 92.6%.

Inadequate iodine levels may negatively influence prevention programs against iodine deficiency disorders.

Nitrate Contamination in Vegetables

Fifty-eight vegetable samples were analyzed.

Sixteen samples exceeded acceptable nitrate limits.

The contamination rate reached 27.6%, representing the most significant chemical hazard identified in the study.

This result indicates potential overuse of nitrogen fertilizers during agricultural production.

3.3 Bacteriological Analysis

Food Product Contamination

Seventy-one food samples underwent bacteriological examination.

Two samples were contaminated.

Although the contamination rate was relatively low, the findings confirm the continuing risk of foodborne infections.

Drinking Water Microbiology

Thirty-one drinking water samples were tested microbiologically.

Four samples were contaminated.

The contamination rate reached 12.9%.

This indicates possible failures in water treatment systems or secondary contamination during transportation and storage.

Environmental Swabs

A total of 820 environmental swabs were collected from:

kitchen surfaces,

equipment,

utensils,

employee hands.

Eighty-one swabs failed sanitary standards.

The contamination rate was 9.9%.

These results demonstrate deficiencies in sanitation procedures and cleaning practices.

3.4 Administrative Measures

Sanitary violations identified during inspections resulted in administrative actions.

The following measures were implemented:

5 employees received administrative penalties,

total fines amounted to 974,500 UZS,

124 sanitary recommendations were issued,

107 recommendations were implemented.

The implementation rate exceeded 86%.

3.5 Staff Survey Results

The survey demonstrated relatively high levels of hygiene awareness among employees.

| Indicator | Correct Responses | Percentage |
|---|---|---|
| **Personal hygiene** | 33 | 94.3% |
| **Cross-contamination prevention** | 31 | 88.6% |
| **Temperature control** | 29 | 82.8% |
| **Iodized salt importance** | 32 | 91.4% |

The average knowledge score was 88.3%.

## DISCUSSION

The findings of this study demonstrate both positive developments and persistent sanitary challenges in railway catering facilities.

The substantial reduction in administrative violations indicates improved sanitary compliance and more effective regulatory supervision. Increased staff awareness and regular inspections likely contributed to this improvement.

However, several important risk factors remain unresolved.

4.1 Nitrate Contamination as a Public Health Risk

The high level of nitrate contamination in vegetables is particularly concerning.

Excessive nitrate accumulation is commonly associated with:

intensive fertilizer use, poor agricultural regulation, lack of supplier quality control. High nitrate intake may contribute to: methemoglobinemia, gastrointestinal disorders, chronic toxic effects, increased carcinogenic risk. These findings indicate that food safety surveillance should extend beyond catering facilities and include agricultural supply chains.

4.2 Microbiological Contamination

The contamination of drinking water and environmental surfaces indicates deficiencies in sanitation systems. Possible contributing factors include: outdated plumbing systems, inadequate chlorination, improper cleaning procedures,

insufficient disinfection monitoring. Environmental contamination is especially important because surfaces can become reservoirs for pathogen transmission.

### 4.3 Human Factor and Hygiene Practices

The study demonstrated relatively high employee knowledge levels. However, contamination persisted despite this knowledge. This finding confirms that theoretical knowledge alone cannot eliminate sanitary risks. Practical implementation depends on: management quality, infrastructure conditions, availability of sanitation supplies, organizational culture.

### 4.4 Importance of Regulatory Surveillance

The study highlights the importance of continuous sanitary surveillance systems. Regular inspections supported by laboratory analyses provide: early detection of risks, prevention of outbreaks, enforcement of sanitary standards, improvement of institutional accountability.

### 4.5 Comparison with International Studies

The results are consistent with international studies conducted in industrial catering facilities. Research from other developing regions similarly reports: persistent nitrate contamination, microbiological risks in water systems, discrepancies between staff knowledge and practical hygiene behavior. These similarities suggest that food safety challenges in industrial catering are global rather than region-specific.

## CONCLUSION

The sanitary and epidemiological condition of railway catering facilities in the Kokand region improved significantly during the study period. Positive developments included: reduced administrative violations, increased staff awareness, improved laboratory compliance. However, major risks remain associated with: nitrate contamination, microbiological contamination, infrastructure limitations. Sustainable food safety improvement requires integrated intervention strategies combining: regulatory enforcement, infrastructure modernization, supply chain monitoring, continuous staff education.

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