Assessment of process hygiene in take-away restaurants at gas stations in Serbia

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Abstract. The present study was conducted to assess the effectiveness of sanitary procedures on food contact surfaces and food handlers’ hands in Serbian take-away restaurants at gas stations. For that purpose, a total of 2518 swabs of food contact surfaces and 709 food handlers’ hand swabs were investigated for microbiological parameters of process hygiene. The results showed that 11.60% (292 of 2518) of swabs from food contact surfaces, and 16.50% (117 of 709) of swabs from the food handlers’ hands were not compliant with the criteria in the self-control plans of the food business operators. Permanent, on-going training of employees on the proper implementation of sanitation procedures is of essential importance to implement effective good hygiene practices and hazard analysis and critical control point plans.

1. Introduction

When eating outside the home, consumers expect to obtain quality food with an acceptable food hygiene level, which reduces the risk for food-borne illness [1]. Food safety is primarily achieved through a preventive approach such as the implementation of a food safety management system based on the principles of Hazard Analysis and Critical Control Point (HACCP) and good hygiene practice (GHP). GHP programs are prerequisites to the implementation of a HACCP system and are essential for the production of safe food [2]. Also, the implementation of HACCP system and GHP are mandatory according to European Union and Serbian Regulations. Despite the legal requirements for the implementation of GHP and HACCP, cross-contamination remains an important causative factor in outbreaks of food-borne disease that occurred in restaurants and highlights the continuing importance of GHP with adequate training of food handlers [1].

Food contact surfaces include food containers, utensils, plates, cooking vessels, cutting boards, slicers, knives, steel pallet knives and spatulas, stainless steel and plastic vessels for food distribution [3]. These surfaces are a major concern for food service facilities in controlling the spread of food-borne pathogens because cross contamination via food contact surfaces has been identified as a significant risk factor [4].

A food handler can be defined as anyone involved in the production or preparation of food at any point in the food chain and can include people repairing, maintaining, cleaning or visiting food preparation areas [5]. Food handlers’ hands have been identified as one of the crucial vectors for dissemination of microorganisms [6]. Microorganisms are transferred to the hands in the process of food handling and due to poor personal hygiene, which can result in the hands being contaminated with enteric pathogens [7]. The food handler and their contact with contaminated surfaces are potential causes of cross-contamination and, consequently, outbreaks of food-borne disease [8]. To prevent the spread of infection, people in the food production and food service industries should be well trained and motivated to follow good personal hygiene practices, to use correct hand washing procedures and to follow these procedures while working [9].
The aim of this study was to investigate suitable microbiological parameters of process hygiene and to estimate the effectiveness of sanitary procedures for food contact surfaces and food handlers’ hands in Serbian take-away restaurants at gas stations, through a three-year period.

2. Materials and Methods
During the three year period (from January 2016 to December 2018), an assessment of the process hygiene was carried out in 24 take-away restaurants at gas stations. Overall, a total of 2518 swabs of food contact surfaces and 709 food handlers’ hand swabs were investigated for microbiological parameters of process hygiene (Table 1).

Table 1. Number of swabs studied in each year

| Year | Food contact surface swabs | Food handlers’ hand swabs |
|------|---------------------------|--------------------------|
| 2016 | 834                       | 232                      |
| 2017 | 846                       | 242                      |
| 2018 | 838                       | 235                      |
| Total| **2518**                  | **709**                  |

2.1. Swab samples
Swab samples from the food contact surfaces and food handlers’ hands were taken after cleaning, washing and disinfection procedures. Sampling was conducted according to the standard method [10]. On the sampling day, swabs were transported to the laboratory in a hand-held refrigerator and analyzed within 24 h. All swabs were analyzed in an accredited laboratory according to SRPS ISO/IEC 17025:2006.

2.2. Microbiological examinations
Swab from the food contact surfaces were analyzed for aerobic colony count (ACC) according to SRPS EN ISO 4833-1:2014 [11], Enterobacteriaceae (ENT) in line with SRPS ISO 21528-2:2009 [12], coagulase-positive staphylococci (STAPH) according to modified SRPS EN ISO 6888-1:2009 [13], and Listeria monocytogenes according to SRPS EN ISO 11290-1:2010 [14]. The swabs from food handlers’ hands were tested for ACC [11], ENT [12] and STAPH [13]. Results of the microbiological analyses were expressed as number of bacteria per cm² (CFU/cm²) and number of bacteria per swab (CFU/swab), for swabs taken from the food contact surfaces and food handlers’ hands, respectively.

2.3. Evaluation of microbiological results
The assessment of the obtained results of microbiological contamination was carried out in accordance with the limit values set by the self-control plans of the food business operators (Table 2).

Table 2. Microbiological criteria in the self-control plans of the food business operators

| Microorganisms                  | Porcelain, glass, smooth metal food contact surfaces | Plastic, wood, stone food contact surfaces | Food handlers’ hands |
|--------------------------------|------------------------------------------------------|-------------------------------------------|----------------------|
| Aerobic colony count           | ≤ 10 CFU/cm²                                         | ≤ 30 CFU/cm²                              | ≤ 200 CFU/swab       |
| Enterobacteriaceae             | ≤ 10 CFU/cm²                                         | ≤ 10 CFU/cm²                              | ≤ 10 CFU/swab        |
| Coagulase-positive staphylococci| ≤ 10 CFU/cm²                                         | ≤ 10 CFU/cm²                              | ≤ 10 CFU/swab        |
| Listeria monocytogenes         | Absence in 100 cm²                                   | Absence in 100 cm²                        | /                    |
3. Results and discussion

During the three year period, in 24 take-away restaurants at gas stations, 3227 swabs were examined: 2518 from food contact surfaces (cutting boards, slicing machines, knives, refrigerator doors, metal working surfaces) and 709 from food handlers’ hands. In 2016, a total of 1066 swabs were examined (834 from food contact surfaces and 232 from food handlers’ hands), in 2017 a total of 1088 swabs (846 from food contact surfaces and 242 from food handlers’ hands), and in 2018 a total of 1073 swabs (838 from food contact surfaces and 235 from food handlers’ hands) were studied (Table 1).

The results showed that 11.60% (292 of 2518) of the swabs from food contact surfaces did not comply with the criteria in the self-control plans of the food business operators. In 2016, 19.42% swabs of food contact surfaces were noncompliant with the set limits in control plans, while in 2017, 10.52%, and in 2018, only 4.89% of swabs were noncompliant (Table 3). These findings are close to those conducted by Legnani et al. [15] in 2004 and Garayo et al. [16] in 2014. The reduced percentage of noncompliant swabs in 2018 compared to 2016 suggests training of employees on the proper implementation of sanitation procedures is of essential importance to effective GHP and HACCP.

The main reason for noncompliant swabs from food contact surfaces in all three years was the high percentage of swabs with noncompliant levels of ACC (2016 – 95.68%, 2017 – 87.64%, and 2018 – 95.12% of all noncompliant swabs). During the study, coagulase-positive staphylococci and Listeria monocytogenes were not detected in any swab from food contact surfaces.

Table 3. Microbiological status of the food contact surfaces

| Year | Number of swabs | Noncompliant N | % | Finding | Frequency n | % | Finding | Frequency n | % |
|------|-----------------|----------------|---|---------|-------------|---|---------|-------------|---|
| 2016 | 834             | 162            | 19.42 | ACC     | 155         | 95.68 | ACC + ENT | 7           | 4.32 |
| 2017 | 846             | 89             | 10.52 | ACC     | 78          | 87.64 | ACC + ENT | 11          | 12.36 |
| 2018 | 838             | 41             | 4.89  | ACC     | 39          | 95.12 | ACC + ENT | 2           | 4.88  |

The results of microbiological examinations of swabs from the food handlers’ hands showed that 16.50% (117 of 709) of swabs were not compliant with the criteria in the self-control plans of the food business operators. The results of food handlers’ hand swabs showed similar levels of hygiene in all three years (the percentage of swabs of food handler’s hands with noncompliant ACC levels: 2016 – 18.10%, 2017 – 15.70%, and 2018 – 15.74%) (Table 4). Again, in swabs from food handlers’ hands, ACC levels (in 94.87% of noncompliant swabs) were the main reason for noncompliant results in all years. Coagulase-positive staphylococci were detected only in one swab in 2016, together with aerobic colony count. This worker whose hands carried coagulase-positive staphylococci was referred to an emergency sanitary examination. Enhanced cleaning, washing, and sanitation of accessories, tools and equipment used by this worker were undertaken.

Noncompliant results, obtained by controlling food handlers’ hand hygiene, indicate the food production workers did not pay enough attention to the proper procedures for maintaining hand hygiene [17].

Table 4. Microbiological status of the food handlers’ hands

| Year | Number of swabs | Noncompliant N | % | Finding | Frequency n | % | Finding | Frequency n | % |
|------|-----------------|----------------|---|---------|-------------|---|---------|-------------|---|
| 2016 | 232             | 42             | 18.10 | ACC     | 39          | 92.86 | ACC + ENT | 2           | 4.76 |
| 2017 | 242             | 38             | 15.70 | ACC     | 35          | 92.11 | ACC + ENT | 3           | 7.89 |
| 2018 | 235             | 37             | 15.74 | ACC     | 37          | 100.00 | ACC + ENT | /            | /  |
4. Conclusion
In order to keep the level of process hygiene at an acceptable level, permanent education of workers is necessary in terms of sanitation procedures of food contact surfaces and food handlers’ hands. Additionally, continuous monitoring of food contact surfaces and food handlers’ hands in accordance with the self-control plans of the food business operators must be conducted using appropriate microbiological analyses.

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