Influence of the Environmental Factors on Contamination of Mediterranean Mussels (Mytilus galloprovincialis)

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Abstract
Mussel harvesting areas in Slovenia are monitored for contamination with E. coli as pollution indicator bacteria. According to contamination levels, areas are classified into A, B or C category. An A category means that there is less than 700 E. coli MPN/100 g of the shellfish flesh and intervalvular fluid. Mussels from the areas with the established A category are placed on the market directly, whereas shellfish from areas classified as B or C category undergo a depurating process. The aim of our research was to gain detailed insight into the contamination with E. coli as well as with some other microorganisms and heavy metals. We also took into account possible factors affecting the contamination of seawater and shellfish (e.g. marine currents, rainfall, tides). During a one-year period 34 samplings at three shellfish harvesting areas and one wild area were carried out (306 samples). Higher levels of contamination were observed in colder parts of the year (spring, winter) and at the time of heavy rainfalls. Correlation between E. coli number in mussels and enterococci in seawater was statistically significant. To ensure safety of the mussels it is therefore important to carry out increased number of samplings at critical periods of the year.

Keywords: mussels, E. coli, safe food

1. Introduction

Bivalve shellfish are filter-feeding organisms and may accumulate microorganisms and other agents present in the surrounding water. Contamination of shellfish is influenced by different factors, such as pollution sources, rainfall, salinity, temperature and many others. Higher concentrations of E. coli in shellfish in autumn and in winter are mainly associated with heavy rains (Riou et al., 2007; Almeida and Soares, 2012). Shellfish harvesting areas in Slovenia: Seča, Strunjan and Debeli rtič are located in the Northern Adriatic, which is characterized by poor circulation of water masses, shallowness and extreme influences of inland waters (Sotlar, 2000). In addition to regional influence, the pollution of the northern Adriatic is due to the economic and urban development of the coastal towns with hinterland.

2. Material and Methods

2.1. Sampling

Samples of mussels were collected at three harvesting areas: at the Seča, Strunjan, Debeli rtič and at one non harvested area near the lighthouse in Debeli rtič. Mussels were transported to the laboratory where bacteriological examination was performed. The number of E. coli was determined according to the ISO/TS 16649-3.

2.2. Statistical analysis

For the statistical analysis we used the program R 3.3.0. We tested differences between E. coli contamination in different harvesting areas and between months of the year. The preliminary homologous variance test showed that variance between the groups differs. Differences in E. coli in bivalve molluscs between harvesting areas and periods of the year were compared with nonparametric Kruskal-Wallis analysis of variance at the sum of ranks. In the case of a statistically significant difference between groups, pairs of groups were compared with each other on the basis of a post hoc test of multiple comparisons. For all tests, the criterion for statistical significance p was <0.05.

3. Results

During the tested period 88.2% of samples did not exceed 230 MPN E. coli/100 g. Among the sampling points, the maximum limit value was exceeded in the free living mussel samples, where the highest contamination values were found. There were individual higher peaks of E. coli in the autumn period at the Seča and Strunjan harvesting areas, but not at the Debeli rtič. During the main bathing season, in the summer months, no value of 230 MPN/100 g was exceeded in any of the sample. Results of E. coli contamination in mussels were collected into trimesters, and in October, November and December 81% of the results exceeded 700 MPN E. coli/100g (Figure 1). The seasonal impact is therefore important, but due to the short period of our study it is not possible to confirm this with certainty.
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