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The analysis of the behaviour of *Listeria monocytogenes* in fresh cheeses with various spices during storage

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Abstract

The aim of this work was to evaluate the growth possibilities of *Listeria monocytogenes* in the artificially contaminated fresh cheese during storage. Three variants of acid homogenized commercial fresh cheeses: mixed herbs, red pepper and garlic-pepper were studied. The lowest value of the specific growth rate of *L. monocytogenes* in the fresh cheeses was reported for red pepper variant. The highest value of this parameter was determined for the fresh cheese with pepper-garlic. The use of spices in the production of fresh unripened cheeses influence the viability and growth of bacteria *L. monocytogenes* during storage at the temperature range 3-15°C.

Key words: *Listeria monocytogenes*, fresh cheese, predictive microbiology, natural preservatives

1. Introduction

Listeria monocytogenes is bacteria that can be found in food products. The consumption of the bacteria present in food may result in listeriosis, which is especially dangerous for people with low immunity, pregnant women, children and elderly people. *L. monocytogenes* grows at chilling storage conditions even at high concentration of NaCl (up to 12%) [4]. Relatively anaerobic rods of *Listeria* can grow at temperatures from -1,5 to 45 °C, in the range of pH from 4,4 to 9,6 [9]. There is a growing number of listeriosis in European Union, the number of cases increased from 1425 to 1763 in years 2008 and 2013, respectively [3]. Among food products with high risk of *L. monocytogenes* occurrence soft cheeses and highly processed food should be mentioned. Dairy products are good substrate for *L. monocytogenes* growth, as they contain proteins, lactose and trace elements. The growth of *Listeria* in such products can be limited by use of food preservatives. However, the consumers often seek the products without any chemical additives, and the food producers tries to address such consumers' needs by launching new or improved food products that are preserved by use of natural substances rather than synthetic one. Some herbs and spices that are used in food production are potentially antagonistic against *L. monocytogenes* [8].

To answer the question: will the undesirable bacteria grow in the food product, it is necessary to carry out a storage study in wide range of temperatures. The results (of studies carried out using the food samples purposely contaminated with pathogens) can be further analyzed by predictive microbiology. Predictive microbiology and mathematical models provide reliable description of microorganism behavior in food. Adequately validated models can be applied for quantitative estimation of microbial risk at real time [5].

The aim of present work was to evaluate the growth possibilities of *Listeria monocytogenes* in the artificially contaminated fresh cheeses during storage at the following temperature: 3, 6, 9, 12 and 15°C. Three flavor variants (mixed herbs, red pepper and garlic-pepper) of acid, homogenized commercial fresh cheeses were studied.

2. Material and Methods

2.1. Materials

The „Gusto” cheese was used in the studies with three different coatings: mixed herbs, red pepper and garlic-pepper. “Gusto” cheese is made of natural tvarog cheese (acid fermentation fresh cheese), cream, stabilizer (gelatin), dietary fiber, locust bean gum and NaCl. The cheese contains ca. 16% of fat and ca. 64% of water; its pH is the range 4,8-4,9. It can be described by delicate, clean, slightly creamy flavor. It is a popular cheese in central Poland with firm and homogenous structure and white color.

2.2. Inoculation and storage

The three strains of *Listeria monocytogenes* (strains ATCC: 0232S, 0737S, 0398S; Microbiologics, St Cloud, USA) were used to contaminate the samples.

In order to contaminate the products, fresh cheeses with three flavor variants (mixed herbs, red pepper and garlic-pepper) were divided into 25 g samples and an adequate dilution of *L. monocytogenes* culture was added to obtain the final concentration at 2 log cfu/g of cheese. The contaminated fresh cheese samples were stored in incubators equipped with cooling mode (ICP, Memmert, Germany) at 3 °C, 6 °C, 9 °C, 12 °C and 15 °C until the final curve of logarithmic growth of *L. monocytogenes* was obtained. The experiment was carried out in three replicates.

In a precise time frame depended on storage temperature, the number of *L. monocytogenes* was determined with Chromocult Agar medium with a selective additive for *Listeria* (according Ottaviani and Agosti) (Merck, Millipore, Warsaw, Poland).

2.3. Mathematical Analysis

For primary modelling, the predictive growth models of Baranyi and Roberts' were used [1] from www.combase.cc.

The square root model described by Ratkowsky, polynomial model and Arrhenius models were used within secondary modelling [6, 10].

The mathematical validation of secondary models included a calculation of the determination coefficient (R^2) as well as bias (B_f) and accuracy (A_f) factors. The B_f factor describes the distribution of the observed values with reference to the line of equality, whereas the A_f factor indicates the average distances between the observed values and the line of equality [7]. The mathematical analyses were performed with MS Excel software (Microsoft, Warsaw, Poland).

3. Results and discussion

The growth of *Listeria monocytogenes* in fresh cheeses with various spices: mixed herbs, red pepper and garlic-pepper, at the temperature range 3-15°C was shown on the Figures 1-3.

The highest level of *L. monocytogenes* cells was determined for "Gusto" cheese with garlic-pepper coating, and the lowest with red pepper coating, independently of storage temperature.

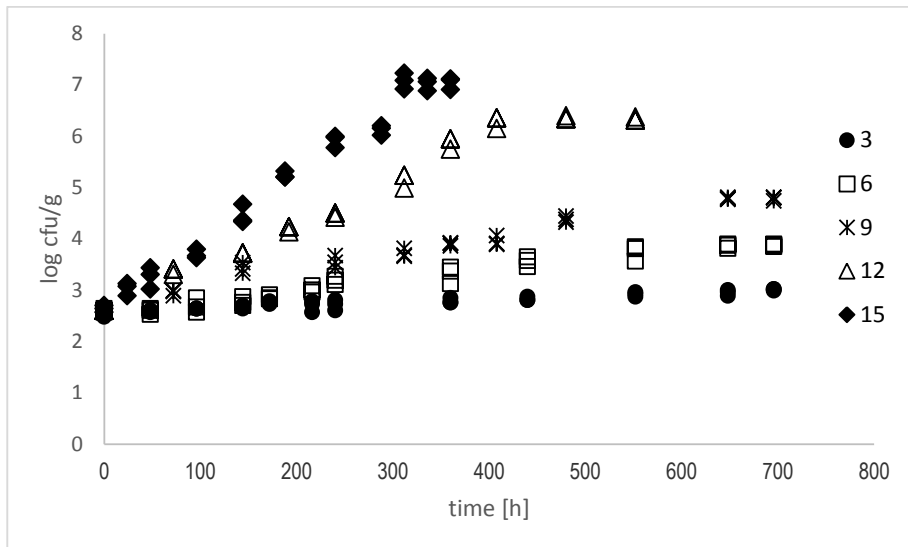


Figure 1. The observed growth of *Listeria monocytogenes* in fresh cheeses with red pepper at incubation temperatures of 3°C, 6°C, 9°C, 12°C and 15 °C.

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