INTRODUCTION

Packaging can maintain the quality and extend the shelf life of foods. To prevent and retard some deterioration of packaged food quality the application of active packaging systems has been proposed. The release of antimicrobial components from packaging to foodstuffs provides one of promising trends in food processing. Antimicrobial packaging can inhibit the growth of pathogenic or spoilage organism on food surfaces, and thus, it can contribute to extending the shelf life of packaged foods [1, 2].

Nisin, a natural polypeptide produced by Lactococcus lactis, has been shown to be able to be incorporated into various antimicrobial packaging films [3, 4]. Nisin containing films have been reported to possess an antimicrobial activity for Gram positive bacteria, such as Lactobacillus, Listeria, Bacillus and Clostridium.

The aim of this work was to study the effect of polyethylene packaging film with nisin incorporated in surface coating layer on microbial stability of packaged sliced salami and processed cheese.

EXPERIMENTAL

Packaging material: polyethylene film (LDPE, thickness 30 µm, Aliachem, a. s., o.z. Fatra Napatjeida, CZ) treated with lacquer (Kombilack L1917, ROTOFLEX, Germany) with or without 5% (w/w) Nisaplin® (Danisco, Brabrand, Denmark) of activity 1 × 10^6 IU/g. The thickness of final lacquer layer was 14 µm and preserving efficiency of the film corresponded approx. 2500 IU nisin per dm².

Processed sliced cheese (content of solids and fat 44.0% w/w and 13.8% w/w, respectively) and sliced ham salami from retail were vacuum packaged using above mentioned polymer packaging films in contact with the both nisin containing lacquer
layer and lacquer layer without preserving agent. A part of cheese was inoculated by *Bacillus cereus* DMF 2008 before tests by dipping into a suspension of this microorganism (density $10^7$ CFU/ml). A part of cheese samples were packaged without use of vacuum in the air atmosphere. The packaged salami was stored at $5^\circ$C for 0–14 days, the cheese at $21^\circ$C for 0–28 days.

During storage the total count of microorganisms (PCA medium, $30^\circ$C, 72 hours) and the count of lactic acid bacteria (MRS medium, $37^\circ$C, 48 h) on the surface of sliced ham salami were determined. The growth of aerobic sporeforming bacteria *Bacillus* sp. (PCA medium, temperature $30^\circ$C, 48 h after inhibition of diluted sample at $85^\circ$C for 10 min) and *Bacillus cereus* (PEMBA medium, $37^\circ$C, 24 h) was followed in cheese.

**RESULTS AND DISCUSSION**

In the Figure 1 the counts of aerobic sporeforming bacteria (*Bacillus* sp.) in the samples of processed cheese are given. The inhibitory effect of anaerobic conditions on the bacteria growth is obvious, especially after 28 days of storage. It is also evident, that packaging material treated by the lacquer with nisin retarded to a large extent the growth of followed microorganisms in all samples. In vacuum packaged cheese the count of aerobic sporeforming bacteria was reduced by 2 logarithmic cycles compared with samples in the film without nisin. In samples packaged in normal atmosphere the decrease of microorganism count by 3 logarithmic cycles was found. Similar results were also obtained for samples untreated by *Bacillus cereus* DMF 2008.

![Figure 1](image1.png)

Figure 1. The growth of aerobic sporeforming bacteria in sliced processed cheese packaged in films with nisin and without it under vacuum and in normal atmosphere

![Figure 2](image2.png)

Figure 2. The growth of *Bacillus cereus* DMF 2008 in sliced processed cheese packaged in films with nisin and without it under vacuum an in normal atmosphere
The Figure 2 enables to compare the growth reduction of the *Bacillus cereus* DMF 2008 strain in inoculated samples of processed cheese. These tests were done using the selective media PEM-BA (Oxoid, Basingstoke, UK). The initial count of bacteria $2.5 \times 10^4$ CFU/g was reduced during storage in contact with the film containing nisin by 5 logarithmic cycles in the samples packaged under vacuum and by 4 logarithmic cycles in the samples packaged in normal atmosphere.

The influence of packaging material on the total bacteria count as well as on the count of lactic acid bacteria on the surface of ham salami is summarized in Figure 3. The inhibitory effect of films with nisin is perspicuous. The reduction of lactic acid bacteria count was more significant compared with that of total bacteria. Decrease of lactic acid bacteria count more than 2 logarithmic cycles was determined after 14 days.

**CONCLUSIONS**

The results of this study have proved, that active systems of food packaging based on the release of nisin from polymer packaging film during storage of food product can provide significant inhibitory effect on the growth of bacteria in processed cheese and meat products.

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**References**


