

Inhibition of Lactic Acid Bacteria and *Bacillus* sp. Growth in Cheese and Meat Products due to Effect of Polymer Packaging Film with Incorporated Nisin

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Abstract: Active packaging systems based on the application of packaging materials with incorporated and/or immobilized antimicrobial agents provides one of promising trends in food processing. The object of this work was to test the effect of polyethylene (LDPE) packaging film treated with lacquer containing 5% (w/w) Nisaplin[®] on the growth of lactic acid bacteria, aerobic sporeforming bacteria, *Bacillus cereus* and on the changes of total count of bacteria in packaged meat products and processed cheese. Pieces of cheese in contact with nisin treated film were stored at 21°C for 0, 7, and 28 days. The obtained results confirmed significant inhibitory effect of such packaging system against aerobic sporeforming bacteria, when the decrease of above mentioned bacteria contamination up to four logarithmic cycles were determined. In contact with sliced salami the significant decrease of total bacteria as well as lactic acid bacteria counts were found. During storage of packaged salami for two weeks at 5°C the total bacteria count on the surface of product in contact with the package dropped by more than one logarithmic cycles, present lactic bacteria were inhibited by more than two logarithmic cycles.

Keywords: active packaging; nisin; meat; cheese; antimicrobial packaging

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 the promising potential to improve storage stability. 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 Napajedla, 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°C for 0–14 days, the cheese at 21°C for 0–28 days.

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

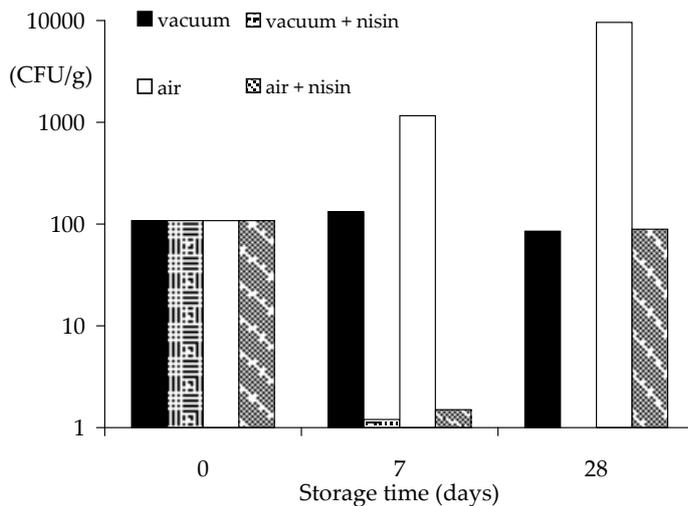


Figure 1. The growth of aerobic sporeforming bacteria in sliced processed cheese packaged in films with nisin and without it under vacuum and in normal atmosphere

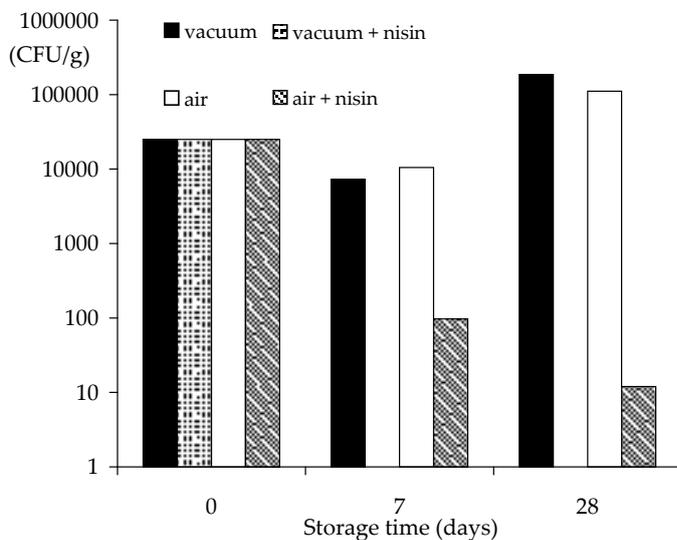


Figure 2. The growth of *Bacillus cereus* DMF 2008 in sliced processed cheese packaged in films with nisin and without it under vacuum and in normal atmosphere

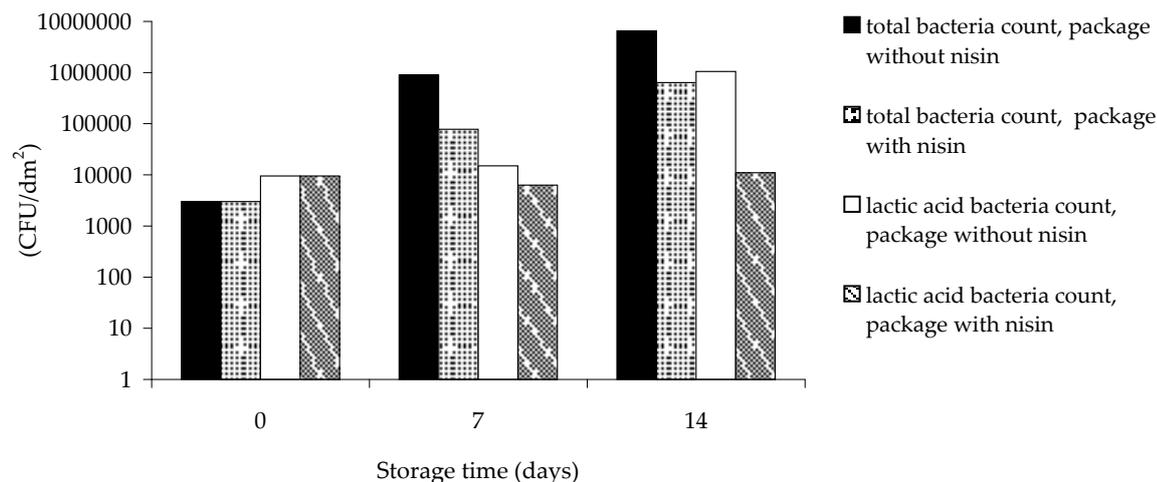


Figure 3. The changes of total bacteria count and lactic acid bacteria count on the surface of sliced ham salami packaged in films with nisin and without it under vacuum

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 2.5×10^4 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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