POLISH JOURNAL OF FOOD AND NUTRITION SCIENCES
Pol. J. Food Nutr. Sci. 2006, Vol. 15/56, SI 1, pp. 161–164

PATHOGENIC AND CONTAMINATING MICROFLORA IN FRESH WHITE CHEESES PACKED WITH DIFFERENT METHODS AND STORED AT LOW TEMPERATURES

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Key words: fresh white cheeses, vacuum packaging, modified atmosphere packaging, pathogenic microflora

The growth of pathogenic microflora was monitored in fresh white cheeses stored for 7, 14 and 21 days at a temperature of 5°C±0.5°C, packed under vacuum, modified atmosphere and air atmosphere conditions. The fresh and stored white cheeses were determined for the numbers of *Listeria monocytogens*, *Enteroccus spp*, coli group bacili, and *Escherichia coli*. The results obtained indicated that the method of packaging had no effect on the development of those microorganisms in white cheeses during their chilled storage.

INTRODUCTION

Vacuum packaging and modified atmosphere packaging (MAP) enable increasing the microbiological shelf life of a number of food products, including fresh white cheeses. The shelf life of white cheeses packed with a traditional method of wrapping into parchment paper or plastics accounts for 5 days, whereas that of white cheeses packed under modified atmosphere may be extended even 6 times. For most of food products, including fresh white cheeses, an undesirable component of atmosphere in their packaging is oxygen which stimulates the growth of aerobic microflora and oxidises multiple food components. Therefore most of the methods used to modify atmosphere in a packaging consists in the removal of that component [Panfil-Kuncewicz & Kuncewicz, 2000a, b; Panfil-Kuncewicz *et al.*, 2001].

One of the methods of atmosphere modification in a packaging involves the application of active packagings with oxygen absorbers. The sensitivity of particular genera of microorganisms to changes in packaging atmosphere composition is different, which results in their differentiated growth in white cheeses packed under vacuum or modified atmosphere.

The objective of the study was to determine the effect of vacuum and active packaging (modification of atmosphere with the use of oxygen absorbers) on the growth of selected groups of pathogenic microflora in white cheeses during their chilled storage.

MATERIAL AND METHODS

The experimental material consisted of fresh white cheeses originated from one dairy plant selected at random. Before packaging, the cheeses were administered with *Listeria monocytogenes* to a level of 10^2 cfu/g. Next, their portions of *ca.* 50 g were transferred into bags made of PA/PE laminate (Cryovac) with the total volume of *ca.* 350 cm^3 and packed on a chamber packing machine (Multivac): one series of samples was packed under vacuum, the second series of samples – with oxygen absorber FT 210 (ATCO) under the pressure of 500 mbar (this method of packing was aimed at reducing the content of oxygen in the packaging and to facilitate the activity of absorbers), whereas the third series of samples was packed under modified atmosphere (control samples). All white cheese samples were stored at a temperature of 5°C±0.5°C for 21 days.

After 7, 14 and 21 days of storage the white cheeses were determined for: (i) the number of *L. monocytogenes* with the plate method [PN-EN ISO 11290-2:2000] on selective Oxford medium (Merck, catalogue No. 107004); (ii) the number of *streptocci* from the *Enteroccus spp*. group – with the plate method [PN-93/A-86034.10] on Slanetz and Bartley's medium (Merck, catalogue No. 105289); (iii) the number of bacili from coli and *E. coli* groups [PN-ISO 4832:1998] on Chromocult Coliform Agar medium (Merck, catalogue No. 110426.0500); (iv) titratable acidity in °SH [Budsławski, 1973]; and (v) the concentration (%) of oxygen in a packaging with the use of an oxygen meter PBI Densensor CheckMate 9900.

Analyses were also carried out on samples of fresh white cheese (before packing). The experiment was conducted in 4-fold replication.

RESULTS AND DISCUSSION

In respect of the safety of food packed under modified

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atmosphere, it is of key importance that the removal of oxygen inhibits the growth of aerobic microflora which causes food spoilage. Deterioration of the organoleptic traits of food products warns consumers of potential hazards. The removal of oxygen is likely to enhance the growth of anaerobic or relatively anaerobic pathogens, such as *e.g. Listeria monocytogenes*, *Yersinia enterocolitica* or *Clostridium botulinum*. Yet, food packed under modified atmosphere may not demonstrate any organoleptic changes over a long time of storage, despite toxins produced by those pathogens and accumulated in it [Farber, 1991].

In the reported experiment, the atmosphere inside the packaging was modified by reducing the content of air and introducing oxygen absorber in the packaging. After 4 hours, the concentration of oxygen in those packagings was observed to drop below 0.5%. The results obtained with this method of packing were compared with the results reported for white cheeses packed under vacuum and in the air atmosphere. The white cheeses examined were deliberately contaminated with *L. monocytogenes*. The average contamination level of white cheeses before packing reached 6.9×10^2 cfu/g. In control samples, after 7 days the population of *L. monocytogenes* was reduced by 2.1×10^2 cfu/g. After 14 and 21 days of storage, further decline was observed in the population number of that pathogen, *i.e.* to 5×10 cfu/g and 1.5×10 cfu/g, respectively. Over the storage period, a decrease in the cell number of *L. monocytogenes* was also observed in the vacuum-packed samples and those packed with oxygen absorber, to a level approximating that recorded for the control sample (Figure 1).

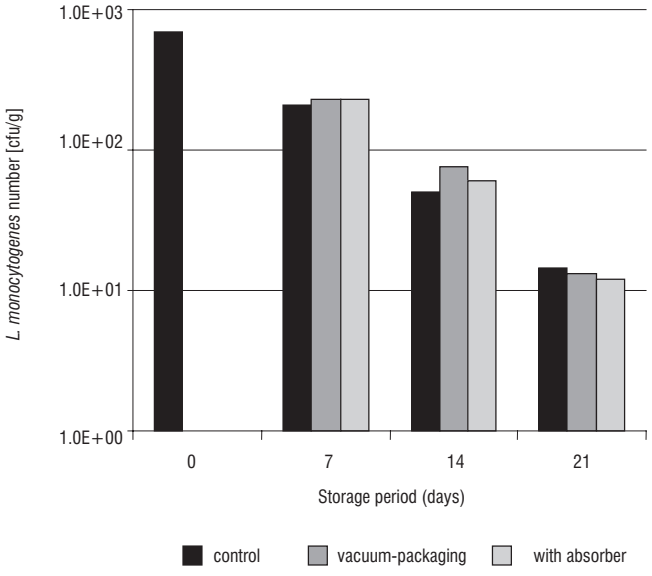

FIGURE 1. The effect of packaging method and storage period of white cheese on the number of *Listeria monocytogenes*.

Similar changes in population numbers of the bacteria discussed during storage were also observed by Stańczak *et al.* [2000], who investigated white cheeses contaminated with *L. monocytogenes* and stored at a temperature of 10 and 20°C. The greatest decrease in the number of those bacteria was recorded by those authors between day 10 and 14 of white cheese storage at a temperature of 10°C. After 14 days of storage, no *L. monocytogenes* were identified in those products. During storage at a temperature of 20°C, a lack of those bacteria was noticed as soon as after 10 days. Piccinin and Schelef [1995], in their study into cottage cheeses previously contaminated with *L. monocytogenes*, reported a decrease in the number of those bacteria over 24-day storage at a temperature of 5°C. Opposite findings were postulated by Fedio *et al.* [1994] in their research into the growth of *L. monocytogenes* in cottage cheeses packed in modified atmosphere and in the air. They demonstrated that over 28-day period of storage (at 6°C), in cottage cheeses packed under natural atmosphere the number of the pathogens examined per 1 g increased by two orders of magnitude (from 10^3 to 10^5). The growth of *L. monocytogenes* in the samples packed in the atmosphere with the following composition: 50% CO_2 and 50% N_2 or 100% CO_2, was not observed until day 28 of storage.

A number of authors have emphasized the existence of antagonism between lactic acid bacteria and development of *L. monocytogenes* baccili. As a result of generation of lactic acid during the production process of fermented foodstuffs, the microorganisms of inocula decrease pH of milk to a value lower than 4.6, which evokes the inhibition of the growth of *Listeria*. In addition, some lactic acid bacteria produce – simultaneously with lactic acid – bacteriocins that inhibit the growth of *L. monocytogenes*. The above-mentioned factors point to a little likelihood of *L. monocytogenes* development in fermented dairy products [Farber, 1991; Fedio *et al.*, 1994; Molska, 1999; Rola *et al.*, 1994; Stańczak *et al.*, 2000].

The results obtained in this experiment did not demonstrate the impact of the composition of atmosphere inside the packaging of white cheeses on the growth of *L. monocytogenes* in those products. This was likely to be linked with a dominating, antagonistic effect of acidifying bacteria on the development of those pathogens in white cheeses. The modification of atmosphere had no considerable effect on the growth of lactic *streptocci*, which was indicated by a slight but significant increase in the titratable acidity of the stored white cheeses.

The number of *Enteroccus spp. streptocci* in the white cheeses analysed was small (3.5×10 cfu/g on average) and practically did not change during the storage of white chesses in different packagings (Figure 2). Similarly low and

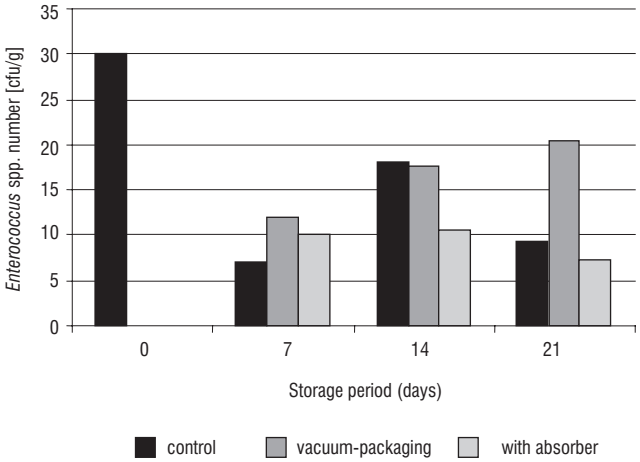

FIGURE 2. The effect of packaging method and storage period of white cheese on the number of *Enterococcus* spp.

unchangeable during storage was the number of coli group bacteria (Figure 3) and that of *E. coli* bacteria (Figure 4). No relationship was found between the number of those bacteria in white cheeses and the method of their packing.

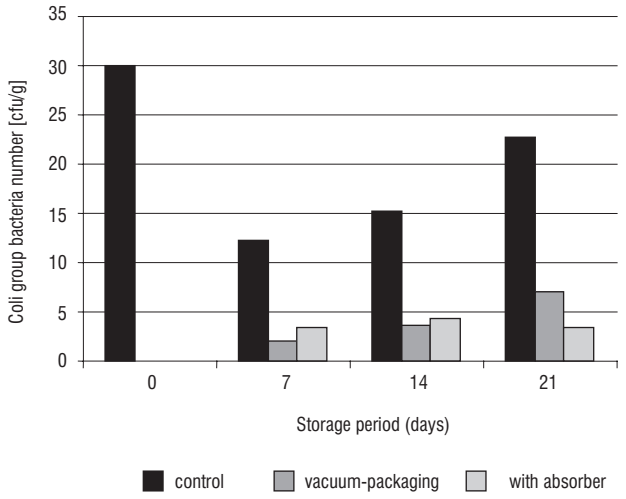

FIGURE 3. The effect of packaging method and storage period of white cheese on the number of coli group bacteria.

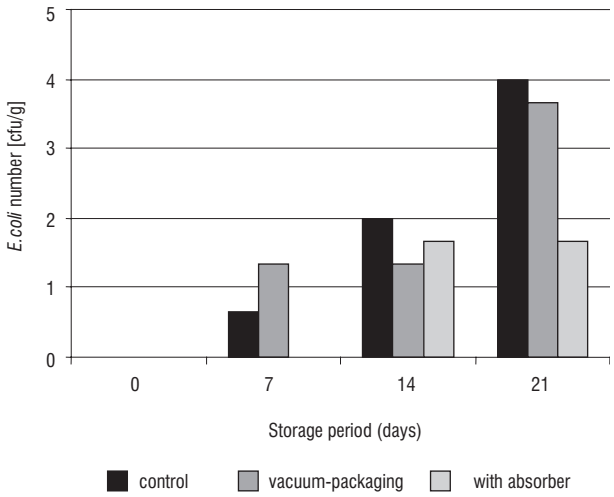

FIGURE 4. The effect of packaging method and storage period of white cheese on the number of *E. coli*.

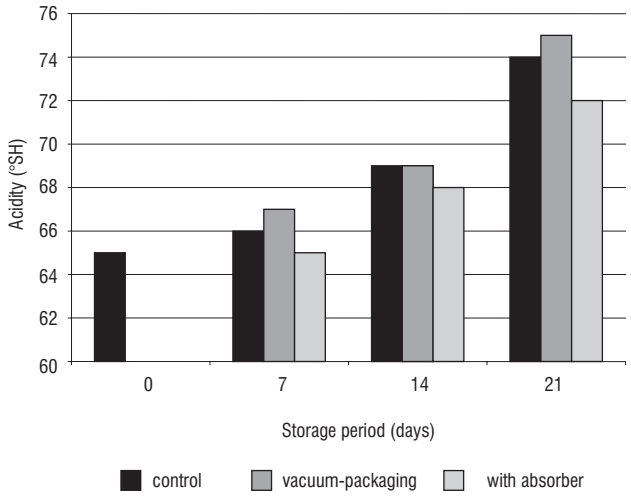

FIGURE 5. The effect of packaging method and storage period of white cheese on titratable acidity (°SH).

It seems that, as in the case of *L. monocytogenes*, the inhibition of the growth of *Enteroccus* and coli group bacteria in white cheeses resulted from a low pH and the antagonistic effect of a large population of acidifying bacteria on the examined groups of bacteria, since the stored cheeses were characterised by a slight but significant increase in the titratable acidity (Figure 5). In this case, of significance was also a high microbiological quality of fresh white cheeses, expressed by a low number of coli and *E. coli* bacteria.

CONCLUSIONS

The results of the study demonstrated that the modification of atmosphere in packages of white cheeses had no significant effect on the growth of the examined groups of pathogenic microflora in those products.

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MIKROFLORA PATOGENNA I ZANIECZYSZCZAJĄCA W TWAROGACH PAKOWANYCH RÓŻNYMI METODAMI I PRZECHOWYWANYCH W NISKICH TEMPERATURACH

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Badano zmianę liczby mikroflory patogennej w twarogach pakowanych próżniowo, w modyfikowanej atmosferze oraz w atmosferze powietrza i przechowywanych przez 7, 14 i 21 dni w temp. 5°C±0.5°C. W twarogach świeżych i przechowywanych oznaczano liczbę *Listeria monocytogenes*, *Enteroccus spp*., pałeczki grupy z coli i *Escherichia. coli*. Wyniki badań wykazały, że metoda pakowania nie wpływała na rozwój tych drobnoustrojów w twarogach podczas ich chłodniczego przechowywania. W miarę upływu czasu przechowywania, niezależnie od metody pakowania obserwowano w próbkach zmniejszenie się liczby komórek *L. monocytogenes* (rys. 1). Liczba paciorkowców *Enteroccus spp*., pałeczek z grupy *coli* i *E. coli* była niewielka i nie ulegała większym zmianom podczas przechowywania (rys. 2, 3, 4).