Effects of treatment with nisin and natamycin on the quality and shelf-life of a Greek soft acid-curd cheese "Galotyri"

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Galotyri is a traditional Greek Protected Destination of Origin (PDO) cheese. It is a soft, white, acid – curd, spread cheese. In the present study, the effect of two natural antimicrobial substances, nisin and natamycin, as well as their combinations, were assessed on the quality, freshness and shelf-life extension of fresh Galotyri cheese, during its refrigeration storage (4 ^{o}C). Galotyri samples stored under aerobic packaging conditions, without any antimicrobial substances added to the product, were evaluated (control samples). Microbiological analyses (primarily total yeasts counts) and sensory evaluation parameters were used in order to estimate the shelf-life of the cheese. The microbiological tests included the enumeration of total mesophilic bacteria, yeasts and moulds, coliforms, lactic flora (*Lactobacilli* and *Lactococci*). Furthermore, physico-chemical quality parameters included determination of pH, fat content, color (L, a, and b) and lactic acid. Sensory parameters being evaluated, included odor, taste, flavor, texture and appearance of the cheese products, both in the control and treated samples. Results of microbiological analyses showed that nisin added, at concentrations of 100 and 200 IU/g, had a small inhibitory effect on the population of *Lactobacilli and Lactococci*, as well as, on the total mesophilic bacteria. Nisin, as expected, seemed to be not effective against yeasts. In contrast, the addition of natamycin, added at concentrations of 10 and 20 ppm (with or without nisin) inhibited the growth of yeasts during the storage period (28 days) maintaining sensory characteristics (unaffected). Moreover, our results, surprisingly, demonstrated that natamycin concentrations had a small, but significant inhibitory effect against *Lactobacilli and Lactococci*. Coliforms were not detected.

Regarding the physico-chemical quality indices, pH and color parameters were practically unaffected upon addition of the antimicrobials. All the pH values revealed after 14th day of storage, no significant differences between the samples. Fat content was stable during the storage period, with no differences between the samples. Lactic acid production, was more or less similar for all samples, following an increase between 1st and 14th day, whereas a decrease was observed on final storage day (28).

Based primarily on sensory evaluation, the shelf-life of fresh Galotyri (control, untreated product) stored aerobically at 4 ^{o}C was approximately 10 days, whereas samples with added nisin at 100 and 200 I /g gave a shelf-life of about 14 days, and finally with the addition of natamycin at 10 and 20 ppm (in combination or not with nisin) a shelf-life of more than 28 days was obtained.

To conclude, natamycin proved an effective "natural" antimicrobial preservative for fresh Greek acid-soft curd cheese (Galotyri) thanks to its significant inhibitory effect on yeasts, the latter being he main causative species involved in the spoilage of Galotyri cheese. In addition, considering mainly the results of sensory analyses with natamycin (in combination with or without nisin) it can be concluded that the addition (incorporation) of natamycin to the Galotyri cheese, stored aerobically at 4 ^{o}C, resulted in a product retaining its original characteristics, and in some cases, with even more improved sensory profile, likely to appeal to the consumer, and a longer shelf-life (18 days).

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