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Reduction of Cheddar cheese ripening time through the addition of glucose

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Introduction

Ripening of cheese consists of complex microbial interactions (S/NLAB) that occur between starter lactic acid bacteria (SLAB) and non-starter lactic acid bacteria (NSLAB). One of the key microbial interactions is growth of NSLAB by utilization of metabolites (various sugars) released from SLAB during cell death. The establishment of a high NSLAB level in cheese is slow, taking several months, but it is a prerequisite for high quality. Therefore, significant cost saving would be achieved if a high level of NSLAB could be established in a shorter time.

This study, using broth models and cheese trials, was performed to optimize and accelerate the SLAB cell death-NSLAB growth interaction.

Materials and Methods

Broth models (adapted from Adamberg et al, 2005) as well as studies in cheese (based on Ortacik et al, 2015) were developed.

1) Broth models were developed by investigating the growth of a commensal SLAB containing Lactococcus lactis subsp. cremoris and subsp. lactis culture (10⁵ CFU/mL) in L/M17 broth with and without supplementation of glucose for 48h, by measuring the optical density (OD) at 600 nm every hour using a microtiter plate reader (Biostat). The broth models were developed in an attempt to increase the growth of NSLAB.

2) Cheddar cheese was manufactured using the same commercial SLAB, with fast cell lysis properties. Glucose was added (0.5 %) at the milking step in an attempt to increase the growth of NSLAB. Cheeses were vacuum packed and ripened at 10°C.

3) Cheddar cheeses were analyzed using standard methods (Figure 2) to measure different levels of NaCl, moisture (7 days after manufacturing). Furthermore, lysed cells, pH, Aw, and microbial counts of SLAB and NSLAB were also measured (immediately after manufacturing and after 5, 9, 13 and 17 weeks ripening).

Results

The broth models showed that the 5 % salt in moisture (S/M) was sufficient to inhibit the utilisation of glucose by the SLAB (Figure 3).

NSLAB increased from levels under detection limit (10⁵ CFU/g of cheese) to levels comparable with other studies (Figure 4). Results indicated no differences on the microbial level of SLAB with 0.5 % glucose compared with no added glucose (Figure 5).

Despite the fact that the levels of NSLAB did not decrease significantly by week 17, changes in aroma of the cheeses were noted, which may be related to the increase of NSLAB levels.

Bacterial cell lysis was estimated by assaying for intracellular X-prolyl dipeptidyl aminopeptidase activity (PepX) in aqueous extracts of the cheese (Figure 6). Results indicated no increase of the level of lysed cells during ripening until week 13, which supports the findings of the microbiological analyses.

Nevertheless, it seems that cheeses supplemented with glucose may have a relatively higher lysis until it became stable and at the same level of the related controls, with no glucose added. Lysis was lower and became stable faster on the cheeses with higher level of salt.

A certain degree of instability was also noted by investigating the pH as well as the water activity (Aw) of the cheeses during the ripening period (Figures 7 and 8, respectively).

Future perspectives

Despite the fact that glucose was depleted from the supplemented cheeses by SLAB, investigation will still be performed using those cheeses, in order to understand the dynamics involved in bacterial interaction when adding the selected SLAB.

Since one of the key microbial interactions is growth of NSLAB by utilization of metabolites (various sugars) released from SLAB during cell death: cheeses supplemented with sugars exclusively utilized by the NSLAB: