Galactose utilization profiles in *Streptococcus thermophilus* strains

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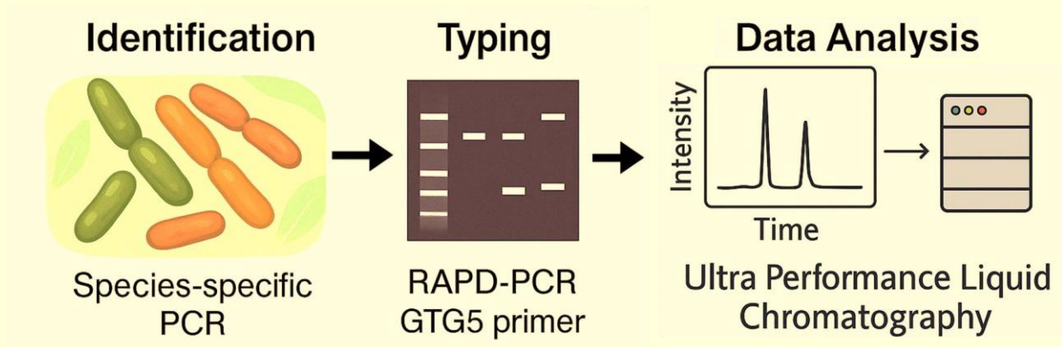
Introduction

Streptococcus thermophilus is widely used in the dairy industry. While glucose is rapidly consumed, many *S. thermophilus* strains lack efficient galactose (GAL) uptake or catabolism, leading to its accumulation in the final product. High residual galactose is undesirable due to potential implications for product quality; in fact, its occurrence is correlated with browning of Mozzarella cheese upon heating. In this study, the galactose phenotype of 100 presumptive *S. thermophilus* strains from dairy origin has been studied in order to develop novel starter cultures for Mozzarella cheese production.

Materials and methods



- Strains were isolated from dairy products
- The strains were identified through a species-specific PCR
- Strains were typed by RAPD-PCR using GTG_5 primer
- The content of lactose, glucose, and galactose was determined by UPLC

Results

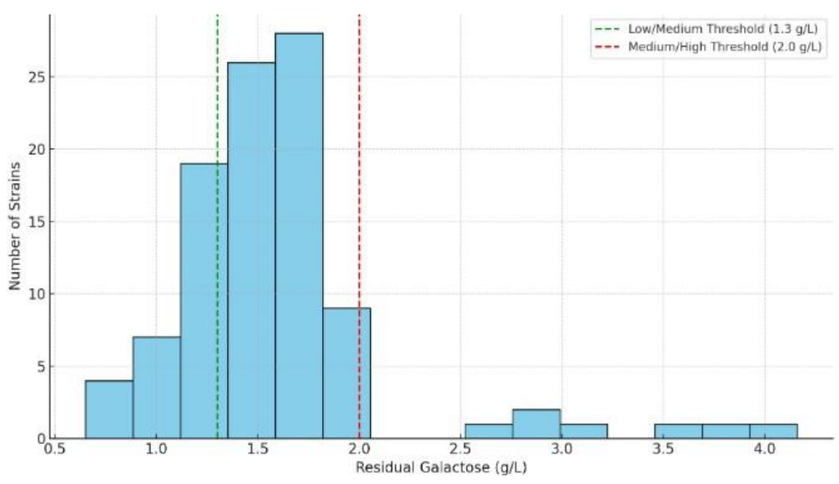


Figure 2. Distribution of residual galactose in *S. thermophilus* strains

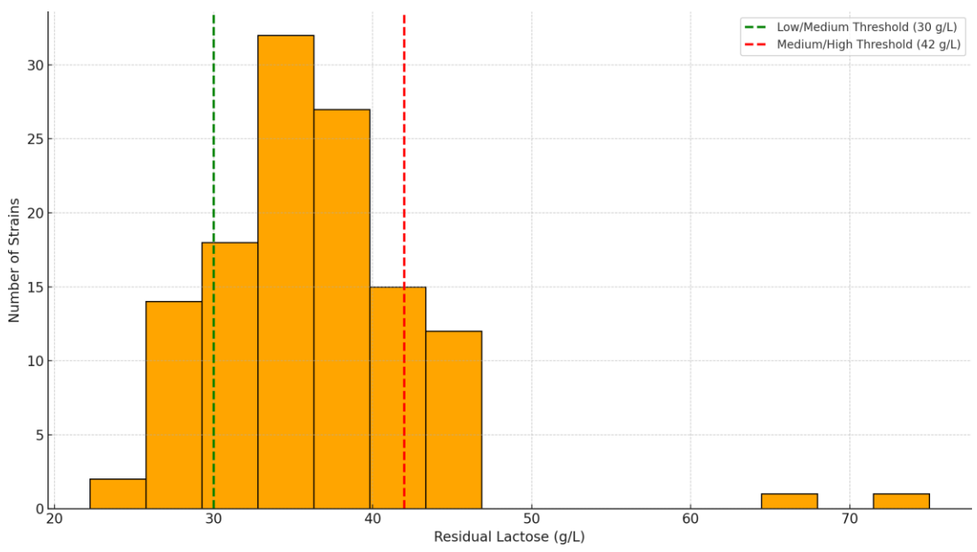


Figure 3. Distribution of residual lactose in *S. thermophilus* strains

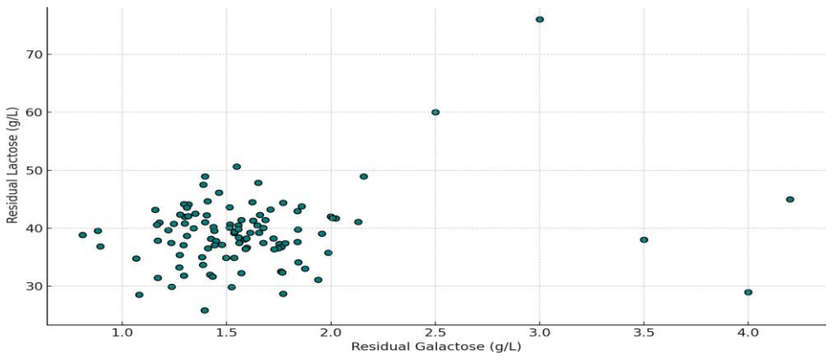


Figure 4. Scatter plot of residual lactose and galactose in fermented milks obtained with the different *S. thermophilus* strains

All strains were identified as *S. thermophilus using* species-specific PCR based on its *lacZ* gene sequence amplification.

Considering a similarity level of 90% 26 clusters were identified and 9 were made up of only a strain (**Figure 1**).

Substantial variability in galactose utilization efficiency was shown (**Figure 2**). The strains were categorized into three phenotypic groups: low-GAL (≤1.3 g/L), intermediate-GAL (1.31–2 g/L), and high- GAL (>2 g/L) users. Approximately one- third of the strains exhibited low residual galactose levels, indicating efficient uptake and metabolism of galactose. Conversely, several strains—most notably those with GAL values exceeding 3 g/L— demonstrated limited galactose utilization, potentially reflecting a gal⁻ phenotype.

Residual lactose concentration ranged from 20 g/L to 76.47 g/L (**Figure 3**).

No consistent correlation was observed between residual galactose and lactose (**Figure 4**).

Glucose was depleted in all strains suggesting a preferential glucose consumption consistent with carbon catabolite repression.

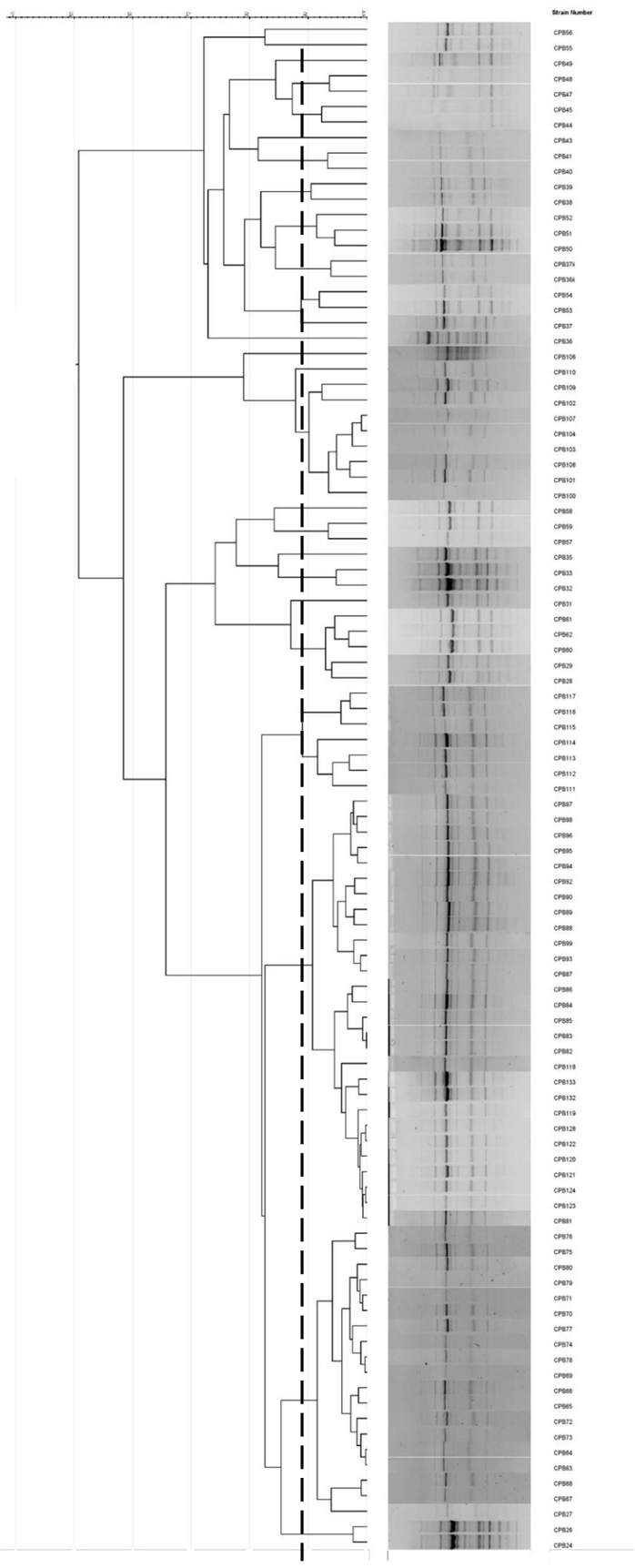


Figure 1. RAPD-PCR cluster analysis. Unweighted pair group method with arithmetic mean (UPGMA) dendrogram derived from comparison of the RAPD-PCR patterns of the yeast strains obtained with the primer GTG_5.

These results showed a galactose fermentation diversity among *S. thermophilus* strains, which could be exploited to develop tailored starter cultures.

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